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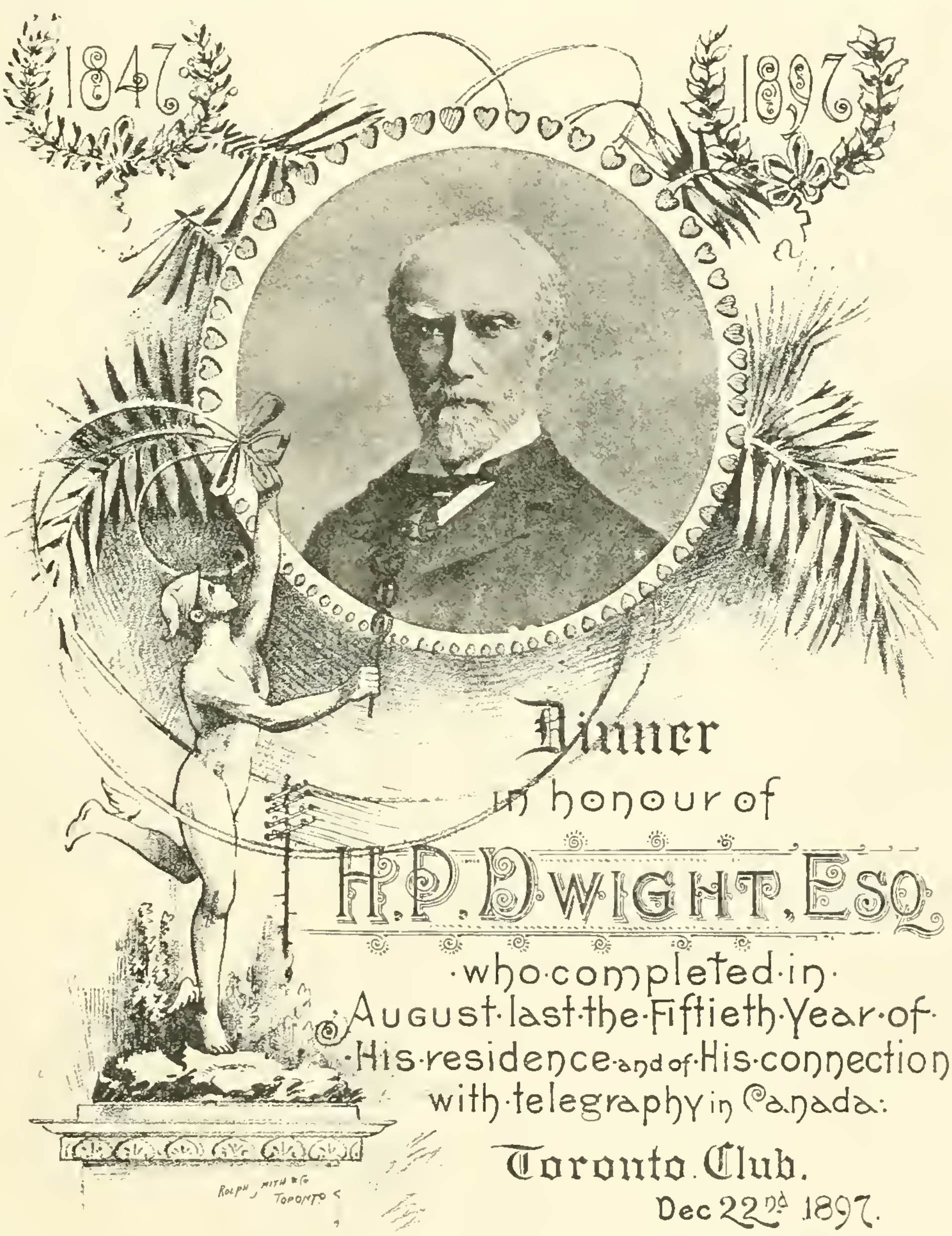
COMPLIMENTARY BANQUET TO MR. H. P. DWIGHT.

Rarely does it happen that a man spends fifty years in the service of one corporation, beginning at the bottom rung of the ladder and climbing to the top, without other assistance than natural ability and indomitable perseverance. Still less frequently is it that one occupying a semi-public position, manages to retain throughout so long a period the good will and high esteem of all his acquaintances and those with whom he is brought into business relations. Such, however, is the record achieved by Mr. H. P. Dwight, president and general manager of the Great Northwestern Telegraph Company, and veteran of the telegraph service in Canada. Notwithstanding the scriptural injunction "Beware when all men speak well of you," Mr. Dwight has cause for the highest gratification in the fact that his conduct during more than half a century has been such as to call forth a spontaneous expression of public esteem such as the complimentary banquet tendered to him by his more intimate friends at the Toronto Club on the 22nd ultimo, and the praise and good wishes from all classes of the community in which he resides.


1847
1897
Dinner
in honour of
H.P. Dwight, Esq.
who completed in August last the Fiftieth Year of His residence and of His connection with telegraphy in Canada.
Toronto Club.
Dec 22nd 1897.
Rolph, Smith & Co Toronto

The banquet, which was presided over by the Hon. G. A. Cox, was one of the most enjoyable and, in every particular, successful affairs of the kind ever held in the city. The character of the table decorations was calculated to remind the company that they had met to do honor not only to a gentleman of tried business ability and manly worth, but also to one who is an ardent sportsman. In the center of the large oval table was a miniature lake in which fishes darted to and fro, and on the surface of which floated fac-similes, to a small scale, of the light birch bark canoe with which Mr. Dwight has become so intimately acquainted in connection with his yearly visits to the Muskoka and Nipissing districts for a quarter of a century past. The menu card, the front page of which is herewith reproduced, was also suggestive in this particular, one page showing an illustration of Dwight camp and its surroundings on Long Lake, Muskoka, followed from this quotation from Rudyard Kipling:

"Who hath seen the beaver busied? Who hath watched the white tail mating?
Who hath lain alone to hear the wildgoose cry?
Who hath worked the chosen water where the ouananiche is waiting,
Or the sea trouts jumping crazy for the fly?
Do you know the blackened timber, do you know that racing stream?
With the raw right-angled log-jam at the end
And the bar of sun-warmed shingle where a man may bask and dream,
To the click of shod canoe-poles round the bend,
It is there that we are going with our rods and reels and traces
To a silent smoky Indian that we know;
To a couch of new pulled hemlock, with the starlight on our faces,
For the Red Gods call us out, and we must go."

The menu card, which was nicely lithographed in two colors, also bore inscriptions such as the following:

> "A sudden thought strikes me—Let us swear an eternal friendship."
>
> "Man is the nobler growth our realms supply,
> And souls are ripened in our northern sky."

The chairman eulogized the many admirable qualities of head and heart of which Mr. Dwight is the possessor, and was followed, in similar vein, by Mr. B. E. Walker, who concluded by proposing the toast to "The Guest of the Evening," at the same time placing in Mr. Dwight's hand a handsome album containing the photographs of all present, and an illuminated address which read as follows:

DEAR MR. DWIGHT,—In August, 1847, you came to Canada to enter the service of which you have been for many years the chief executive officer. Of these fifty years of continuous residence in the country of your adoption, forty-seven have been spent in Toronto.

In the course of your long connection with the telegraph system of Canada you have seen it grow from small beginnings to its present large proportions, and it has been your fortune to aid, more than any other individual, in its great development.

While seeking to honor you for your persistent devotion and signal ability in enlarging the use and extent of this wonderful machinery for diffusing information, we desire more warmly still to honor that quality of unselfishness which, while you held no public office and sought no reward, has prompted you throughout a long life to do innumerable public and private acts of usefulness and kindness. Nor can we forget that there are many persons scattered over this continent, besides those gathered here, who have long admired your energy in a great and arduous work, your steadfastness in trying circumstances, and your consistent uprightness of character throughout.

We have, therefore, invited you to be present with us to-night, in order that this small section of your host of friends may drink with you the loving cup in commemoration of an eventful year in your life, and as a token of our personal affection.

Mr. Dwight replied with deep feeling, expressing his sincere appreciation of the honor conferred upon him, after which he read a very interesting sketch of his life, in which are embodied many reminiscences of the early history of telegraphy in Canada. He said:

I was brought up on a small, stumpy, stony farm of 25 acres, a few miles south of Oswego, where my father, with such assistance as I could render him, occupied his spare time in making flour barrels for the mills at that then small village at the mouth of the Oswego river. When about 18 years of age it dawned npon my mind very forcibly that I had better get away and find some way of making a better living for myself, and with better prospects if possible than I seemed likely to ever find at home. The erection of a telegraph line had just been completed between Oswego and Syracuse, and I made application and obtained permission to enter the Oswego office, in order to learn the business of an operator. I had heard about this time that a telegraph line was being built by the Montreal Telegraph Company in Canada, where I thought I might get employment. After ascertaining the name of the superintendent, Mr. O. S. Wood, I wrote to him applying for employment, and received a prompt reply, in which he asked me to report myself as soon as I was able to manage a small office, which in due course I did. I came over from Oswego to Kingston on the 27th of August, 1847, where I met Mr. Wood by appointment, and proceeded with him on the same day to Belleville, for the purpose of opening an office there, on the line which had been erected during that season between Quebec and Toronto, a distance of 500 miles, on which some 12 or 15 offices were being opened. Mr. Wood, I might mention, was the first pupil of Prof. Morse, the inventor of the Morse system of telegraphy, and one of his most intimate friends. We took instruments along with us, and opened the office in Belleville the following day, where I was left in charge, and where I performed the duties of both operator and messenger and remained for a couple of months. At the end of that time I was ordered to Montreal, to take my place in that office as an operator. In these early days, I may tell you, a telegraph operator was looked upon as of some importance, and the telegraph office as a decided curiosity.

EARLY ACQUAINTANCES.

During my stay in Belleville I became acquainted with Mr. John Ross, now Hon. John Ross, Mr. William Darling, and Mr. Mackenzie Bowell, the young editor of the Belleville Intelligencer, now Sir Mackenzie Bowell. A few months ago I received a letter from Sir Mackenzie in which he wrote as follows: 'Seeing your name reminds me of the time about 50 years ago when you were a telegraph operator in Belleville, when you one day read off from the instrument, while I copied down, the first telegraph news despatch ever sent over the wires, and which I printed in my little newspaper.'

I took my place as operator in the Montreal office, and remained there until the spring of 1850. While acting as operator I also acted occasionally as messenger, batteryman, line repairer, and, in fact, did everything more or less that was necessary to be done in connection with the business of the office. During the time I was in Montreal our staff consisted of four or five persons, Mr. Wood, our superintendent, myself as chief operator (and sometimes the only one), one or two clerks, and one messenger, a faithful old soldier, who delivered messages with a good deal more reliability than speed.

I remember well being terrified and almost paralyzed one day when the clerk from the outer office came rushing into the operating room in an excited manner, to tell me that Lord and Lady Elgin had called to see the working of the telegraph, and almost before I knew it they were both beside me as I was sending a message over the line. They were accompanied by Lady Alice Lampton and Lord Mark Kerr. Mr. Wood, our superintendent, soon came in, and relieved me from the duty of explaining to the distinguished party the working of the instruments.

The Postoffice Department, at the time I was in Montreal, was in charge of the English government, and the Postmaster-General, Mr. Stayner, was stationed in Montreal, as I have special occasion to remember. A mail steamer was one day reported from below in a message addressed to Mr. Stayner. Knowing that this news was being anxiously looked for, and on discovering that our only messenger was out on his rounds, I put on my cap and ran to the postoffice, a short distance up St. James street, without waiting to put the message in an envelope, and delivered it in breathless haste to the great man personally. Instead of receiving thanks, however, for my zeal, I was treated to the severest kind of reprimand for the liberty I had taken in delivering the message in such an informal manner. It is needless to say I never repeated the offence.

REMOVED TO TORONTO.

In the spring of 1850 I was sent to Toronto to take charge of the company's business here, and to be in a position to recommend such extensions in the province of Ontario as might seem desirable. During my first year in Toronto I sent and received myself on the instruments every message which passed over the line to and from this point. These messages were delivered by one small, freckle-faced Scotch boy, with a plentiful growth of hair on his head, named Robert Easson. I remember well how he ran with his messages as if his very life depended upon it. That boy is now in charge of our Press News Department, and is here to-night. You will notice that he has scarcely a particle of hair on his head.

I had not been long in Toronto before I began to suggest to the head office various extensions of our lines; and as these suggestions were almost invariably adopted, I grew bolder and more reckless, until the head office began to get nervous and frightened. It was finally concluded, however, and I was notified by Mr. Wood, our superintendent, that I should have carte blanche to do as I liked, it only being required that I should give notice each winter of what lines I proposed to build during the ensuing season. During the following years arrangements were made for building a line along the Great Western Railway, and from time to time other railways, as they were projected and built in Ontario, such as the Port Dover & Lake Huron, the Toronto & Nipissing, the Northern, North Simcoe, Port Hope, Peterboro & Lindsay, the Midland, Grand Junction, Victoria, Hamilton & Lake Erie, the Hamilton & Northwestern, the Lake Simcoe Junction, Welland, Whitby & Port Perry, the Victoria, the Toronto, Grey & Bruce, etc. Not only did we arrange to build lines along these different railways, most of which were afterwards consolidated with the Great Western, and the Great Western and finally all the others with the Grand Trunk, but we also covered all the principal highways in the province. I remember well an occasion when a rather sarcastic enquiry came from the secretary of the Montreal Telegraph Company, as to whether I had found any more saw mills to which I proposed to extend the lines. The policy of extension adopted, however, turned out to be a fortunate one, and to-day the map of wires covering the country looks like a thickly woven spider's web, through which a fly could scarcely escape. There is hardly a town or village of the least importance in the country which is not included in this net work of lines, to say nothing of the present telephone system, so that instantaneous electrical communication is almost within the reach of every man's door.

I trust it may be considered a pardonable pride on my part that I have had something to do with the extension of an enterprise which has done so much towards facilitating the business and promoting the happiness of the Dominion and the world generally, and I have always esteemed it a matter for thankfulness that my attention was turned at an early time in this direction.

When I commenced my career as an operator there were only two railways in the country, a short line of nine miles between Montreal and Lachine and the other between Laprairie and St. Johns. There was not a mile of railroad in Ontario or any other part of the Dominion, and, as illustrative of how one enterprise may help another, it may be said that railway traffic is enormously increased by the assistance rendered by the telegraph in facilitating the movement of trains.

FROM HIGH TO LOW RATES.

The tariff on messages in the early days was reckoned in Halifax currency, not dollars and cents as now. On any extensions of the lines in any direction a small additional rate was charged on through messages, until finally, after a great many extensions had been made, the tariff became a complicated affair; charges ranging from 1s 3d to 5s or 6s, and it became a question for careful consideration as to how so complicated a scale might be simplified. My advice was asked for in the matter, and I procured statements from all the different offices showing the exact number of messages handled under the different rates. From these statements it was discovered that over 90 per cent. of the messages sent were under the lower rate, and, consequently, between offices nearest to one another. I submitted a report to show that the difference between these high rates and a uniform rate of 25 cents would involve no great loss to the company, even if there were no increase in the number of messages, while it would appear to the public a very great concession, and recommended that the uniform rate should be adopted, which was done. The consequence was that business soon began to increase between remoter points on the line, and the policy proved satisfactory to all concerned.

You are all well acquainted with the extraordinary development in the application of electricity, as shown in the telephone, electric railway, fire alarm systems, transmission of power, and in other directions. It has been a common saying ever since I entered the business that electrical development was only in its infancy, and, notwithstanding all that has taken place, I am still convinced that the saying is almost as true to-day as it ever was. Great as the development has been in the past, there is a vast field in the future yet to be occupied. Not only will every water fall and rapid be utilized for the production of electrical energy, but the force in every gale of wind will be called into use for the same purpose. Electric or trolley lines of railway will be extended over all the principal highways of the country, and all steam railways will be run by electric power. Our houses will not only be lighted, but heated, by electricity, and we shall require no more coal in our houses for any purpose. Horses will largely disappear, and we shall have better and cleaner streets. Tall and smoky chimneys will disappear. Every farmer will have an electric motor for use in his work of various kinds, and this wonderful energy will be conveniently available in cities and towns everywhere throughout the country for any and every purpose under the sun where power is required.

MANY INGENIOUS IMPROVEMENTS.

Our system of telegraphs is in some respects precisely the same as when I learnt the busines fifty years ago, but there have been many ingenious improvements made in the instruments and in the use of the wires. One of these improvements is what is known as the quadruplex system—that is, the use of one wire between two terminal points, Toronto and Montreal, for instance, made to answer the purpose of four—one real wire, three phantom wires. Four operators do duty at each end of the line, and work independently, precisely as if there were four separate wires. Before this method of using the wires was discovered such a thing would have seemed as impossible as it would now to make a single railroad track answer the purpose of four independent lines. Successful experiments have recently been made in sending messages for a considerable distance without any wires at all. These electrical matters are full of wonders. I never get into a trolley car but I think of how wonderful a thing it is that by mere contact with a slender overhead wire the power of 40 horses can be brought into the motor, as well as current that can be utilized to heat and light the car. It is a wonderful thing that a slender wire strung about the city should be made to burst out into a thousand brilliant lights at different points wherever required by the simple insertion of a certain amount of resistance to the flow of current at given points on the wire. It is a marvelous thing that by speaking into a simple little instrument, which contains a small metal disc, which corresponds to the drum of the human ear, our voices can be carried for 100 or 500 miles, and recognized by our friends at the other end of the wire, as distinctly as if we were together in the same room. These and other electrical developments are wonders which no man can explain. Can you wonder that such a business should be of sufficient interest to keep me in connection with it for 50 years? If I were to fall heir to a million dollars to-morrow I would ask leave of absence from my work long enough to vigit Egypt, but only on the condition that I might return to my work again, and continue in it as long as possible. While the business with which I am connected has had its worries and anxieties, as well as other business has, its still retains for me its attraction, and I hope to be allowed to take an active part in it as long as I am able to be of any use or service.

It has been one of the pleasures of my later years to know that so many operators who learned their business upon our Canadian lines are now filling important positions with other companies. Upon taking a trip over the line of the C. P. R. to British Columbia, in company with my friend, Mr. Fred Nicholls, and returning over the Union Pacific, at many of the stations along the route, both coming and going, in British Columbia and the United States, I was constantly accosted by operators, station masters and others, who reminded me that they were once operators on our Canadian lines, and had kindly recollections of their Canadian associates. I have reason to know, for I have often been told, that Canadian operators are looked upon most favorably by their employers in the United States. During the American War some of the most expert field operators were Canadians, and the celebrated Southern Raider, Morgan, had on his staff an operator named Ellsworth, who became celebrated during the war, and who learnt his business in our Whitby office.

The Canadian General Electric Company have recently shipped to the Canadian Pacific Railway, for lighting their construction shops at Fort McLeod, N.W.T., a 400 light incandescent plant, from which constant potential arc lamps will also be operated.

A company from Bellechasse, Que., have asked for letters-patent, under the name of the Ste. Philomene Telephone Company. They will place telephones in the counties of Bellechase, Montmagny and Dorchester, with headquarters at St. Raphael, and a capital of $1,500.

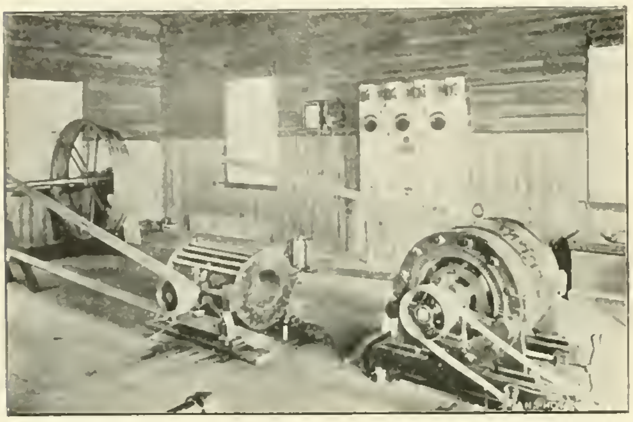
Friends of Mr. J. A. Kammerer, manager of the Toronto branch of the Royal Electric Company, will regret to learn that one week ago he was stricken with typhoid fever. Although the critical point has, perhaps, not yet been reached, it is hoped his constitution will prove sufficiently strong to overcome the disease, and that he may soon be restored to convalescency.

A comparative statement of earnings of the Montreal Street Railway shows the earnings for December last to have been $113,128.91, as against $103,116.02 in 1897, an increase of $10,012.89. The total earnings for the first three months of the fiscal year, viz., October, November and December, were $340,351.60, as against $313,44.97, an increase for the three months of $27,306.63.

The Guelph Light & Power Company have decided to replace their arc lighting machinery for supplying the street circuits with the latest and most approved machinery for the purpose, and have placed an order with the Canadian General Electric Company for an 80 light Brush arc machine, equipped with automatic regulator. These large Brush machines, of which eight, having a capacity of 125 lights each, have beeen purchased by the Toronto Electric Light Company, four of the same size by the Montmorency Company of Quebec, and four for direct connection to synchronous motors by the Lachine Rapids Hydraulic & Land Company, represent the successful development of arc lighting machinery along the lines which have been established as approved practice in direct current and alternating work.

THE GRAVENHURST LIGHTING PLANT.

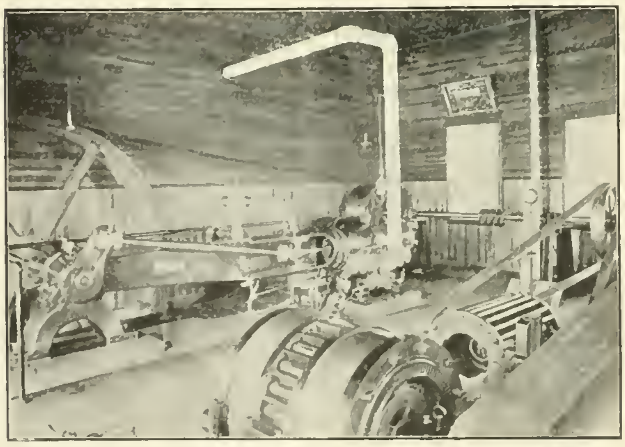
The town of Gravenhurst, situated at the south end of the Muskoka Lakes and a divisional point on the line of the Grand Trunk Railway, with its population of about 2,500, and its celebrated hospital for the cure of pulmonary diseases, since the fall of 1892 has enjoyed the benefits of electric lighting, having its streets illuminated by arc lights and its stores and residences by incandescent lights. The first electric light plant, installed by the Gravenhurst Electric & Trading Co., and situated in a lumber mill at the lakes, was operated with indifferent success until about a year ago, when it was purchased by Mr. E. Fletcher, who formed the Gravenhurst Electric Light & Power Company.



Gravenhurst Lighting Plant—View of Generators.

The new company built a power house on the shores of Lake Gull, closer to the town, and with easy access to wood and water. The station is a substantial brick structure, and almost fire-proof. The new steam plant, of which a view is given, consists of a Wheelock engine of 150 h.p. and a boiler of the same size, both purchased from the Goldie & McCulloch Co., of Galt. This slow-speed simple condensing engine and boiler of the ordinary tubular flue style has proved to be an eminently efficient combination, and one with which the company is well satisfied.

Upon taking possession of the business, it was decided by the new company to remodel the entire old plant. The primary wiring was overhauled, and the secondary system changed from 52 to 104 volts, substituting throughout Stanley transformers for those of the old type. In the station the old single-phase alternator of the revolving wire-wound type was replaced with a 50 k.w. S.K.C. two-phase generator, and the T.H. arc system, which had given the old company good results, was kept in service.



Gravenhurst Lighting Plant—View of Engine Room.

The new plant was started about fifteen months ago, and from that day until the present time Gravenhurst has not been without light for street or indoor purposes. The company have now upon their system over 1,100 incandescent lights and 16 arc lamps, and Mr. Fletcher's management has proved a success both from an operating and financial standpoint.

The corporation of the town of Gravenhurst will in January next submit a by-law to the ratepayers asking for $9,000 to purchase the electric lighting system and $25,000 for a new waterworks system.

Mr. E. Fletcher,
Manager Gravenhurst Electric Light and Power Company.

SAMPLES OF SCALE AND FEED WATER WANTED.

Mr. Wm. Thompson has in course of preparation for this journal a series of articles on "Corrosive and Scale Forming Agents in Boiler Feed Waters." To make these articles of special value to our readers, Mr. Thompson wishes to receive from responsible steam users in all parts of the Dominion samples of scale and feed water, accompanied by as full particulars as possible. It is Mr. Thompson's intention to make complete analysis of the various samples, using them as practical illustrations of the formation of scale through various sources. These samples should be addressed to Mr. Thompson at Montreal West, Que.

THE TORONTO ELECTRIC LIGHT COMPANY'S ALTERNATING PLANT.

The Toronto Electric Light Company are now installing in their new station four 200 kilowatt, 60 cycle single phase alternators of the Canadian General Electric Conpany's latest type. These machines are of the iron-clad armature type, and embody the most recent improvements in the design and manufacture of alternating generators for lighting service. They will be belt driven from the large vertical engines recently installed for the company by John Inglis & Sons, each engine driving a pair of alternators and a 450 kilowatt direct current generator.

The plant of the Phelps Machine Co., of Eastman, Que., has been bought out by the Jenckes Machine Co., of Sherbrooke, who will continue the manufacture of the Dake engine in their Sherbrooke works.

THE STEAM ENGINE GOVERNOR AND ITS REGULATION.*

THE matter of governing steam engines for a uniform speed under the greatest variation of load and steam pressure, and the economy in the use of steam, is no doubt one of the principal features in steam engineering, and I believe the same is absorbing more thought and receiving more attention from the engineer and engine builder than any other adjunct of the steam engine to-day. I will endeavor to point out the fundamental principle upon which the governor acts, and why it acts. There are two conditions of principle, one known as the centrifugal and the other inertia action. The ordinary centrifugal fly ball governor consists principally of a pair of cast iron balls or weights suspended on an arm and at an angle of about thirty degrees from its vertical axis, and made to revolve round its axis as free as possible, generally driven by a pair of mitre gears. This principle of fly ball or centrifugal governor was embodied in the first governor invented by James Watt, which has been more resorted to than any other, but aside from this the governor has been so improved, altered and reconstructed since its time as to be almost unrecognizable. Still the old principle is there, as well as nearly all, if not all, the prominent defects which so materially interferes with its efficiency. The three principal defects are: 1st, friction; 2nd, unbalanced force, caused by the different position of the levers and arms; 3rd, unequal resistance offered to counteract the centrifugal force.

Now, we will take the first, friction. It may be said it has been fairly well overcome for the most practical purposes, so far as the builders are concerned; but much depends on the engineer, as it is his place to see that no excess friction is allowed through improper lubrication of the working parts, poorly packed valve stems, etc.

Then the second is unbalanced force. This defect appears to be much more difficult to overcome and is certainly a greater detriment to the action of the governor. Like other parts of the steam engine, some governors are designed much worse than others in this respect, but the best of them are a long way from being perfect, and the reason may be explained in this way: Suppose, we take, for example, the ordinary centrifugal fly ball governor, and assume that the balls are travelling round in their normal plane, and that the arms are at an angle of 45 degrees and travelling through the path of a 12 circle. The engine is now running 100 revolutions per minute, and the mean effective pressure is 40 pounds. So long as these conditions are left that way, and there is no change in the load, the speed of the engine will be most perfect. But we cannot maintain this, so we will suppose the first change to be that the steam pressure shown by the gauge is allowed to increase. Now, then, the mean effective pressure becomes greater and the engine begins to move faster, and the governor in turn; now there has been a change. The balls have moved to a higher and wider plane. This change simply means that the line of force has become closer to right angles with the vertical axis of the governor, therefore travelling through a greater radius, and the line through the point of gravitation has become farther away from the fulcrum, therefore the speed has to be increased to overcome the increased weight of gravity, caused by the change of angularity, and so the engine continues to increase in speed until enough momentum has been stored to balance the balls in their new position. Therefore it is quite consistent that the force that will support the balls in one plane will not support them in a higher one. Consequently the speed of the engine must vary when controlled by such a governor.

The third was said to be unequal resistance offered to counteract the centrifugal force. This is sometimes applied by a lever and ball and sometimes by a spring. Where the ball is used we still have the same trouble as in the second fault, namely, angularity, and where the spring is used, it is much worse than the ball, because the tension of the spring increases as the spring is drawn out. For example, if we have a spring attached, and offered 20 lbs. resistence when it was drawn out say one inch. Supposing now that part of the load was thrown off, the balls would then have to be speeded up to a higher plane, say enough to cause the springs being drawn out another inch; then the spring would be holding 40 lbs. and of course the balls would have to be speeded fast enough to support this extra 20 lbs. Possibly this might mean two or three revolutions faster for the engine.

The object of applying resistence to the governor may be said to have two purposes: First, to assist the gravitation of the balls when coming to a lower plane, and, second, to permit the changing of the speed of the engine by adjusting the ball or spring until the required speed is maintained.

This resistance, however, has been made automatically adjustable by several inventors in the last few years. This has bettered matters considerably, but still the speed of the engine must change before the attachments are caused to act. So, as it is, the engine has first felt the change of load, causing it to slow up in speed, then the governor feels the change, which in turn causes the attachment to act, therefore it is just a little too late in acting, as the speed has already slowed up, but if the governor had felt the change before the engine, then things would have been different; and so it is with the centrifugal governor that the momentum has to be increased to act one way, and decreased to act the other way. Now, I will leave the centrifugal governor and take up the other principal of governor called inertia. As it would make this paper very lengthy to go fully into this, I will only endeavor to touch on a few principal points.

First, we will suppose this to be connected as a shaft governor. The principal part of this apparatus consists of one straight arm with a fixed weight on each end, and pivoted in the centre to a fixed point of the wheel near the centre of the shaft, thus allowing the balls to move in a rotating direction only, and always in the same plane, thereby doing away with the troublesome change of angles as well as the use of the centrifugal action; there is a spring attached to the arm about the centre of its radius and the other end to the rim of the pulley which surrounds the governor. This spring is used to offer resistance to the acting energy of the rotating weights, and also to assist the momentum in opening the valve. It will be seen that when this apparatus is put in motion the pulley and engine will gradually advance ahead of the suspended weights and continue on so until the valve is adjusted to the proper cut-off to balance the load, and when any extra load is felt by the engine the weights will continue to go on in advance of the engine, thereby increasing the travel of the valve and permitting a later cut-off. So with this apparatus there is no reversing of motion before the governor responds.

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[*] Paper read by Mr. F. G. Mitchell, president Ontario Association of Stationary Engineers, before the Hamilton branch, C A S.E., December 28th, 1897.

ERRATUM.

In the paper on the "Indicator" read by Mr. Wickens and published in our last number, two errors occurred. The last sentence of the paragraph ending nearly the centre of the second column should read as follows: "The height of the diagram at the first point of measurement is $\frac{3}{40}$ less than two inches, and represents 77 lbs.; the second is exactly 2 inches, representing 80 lbs.; 3rd, 80 lbs.; 4th, 57 lbs.; 5th, 41½ lbs.; 6th, 34½ lbs.; 7th, 27 lbs.; 8th, 20 lbs.; 9th, 16 lbs.; 10th, 13 lbs., making a total of 446." In the eighth line from the end, the words "piston across head" should read "piston and cross head."

ENJOYS IT VERY MUCH.

MR. Geo. W. Vincent, of Acton, Ont., in remitting his subscription to the ELECTRICAL NEWS, writes: "I enjoy the paper very much, and hope to continue taking it.

The board of directors of the Hull Electric Company have appointed Mr. W. R. Taylor as secretary-treasurer.

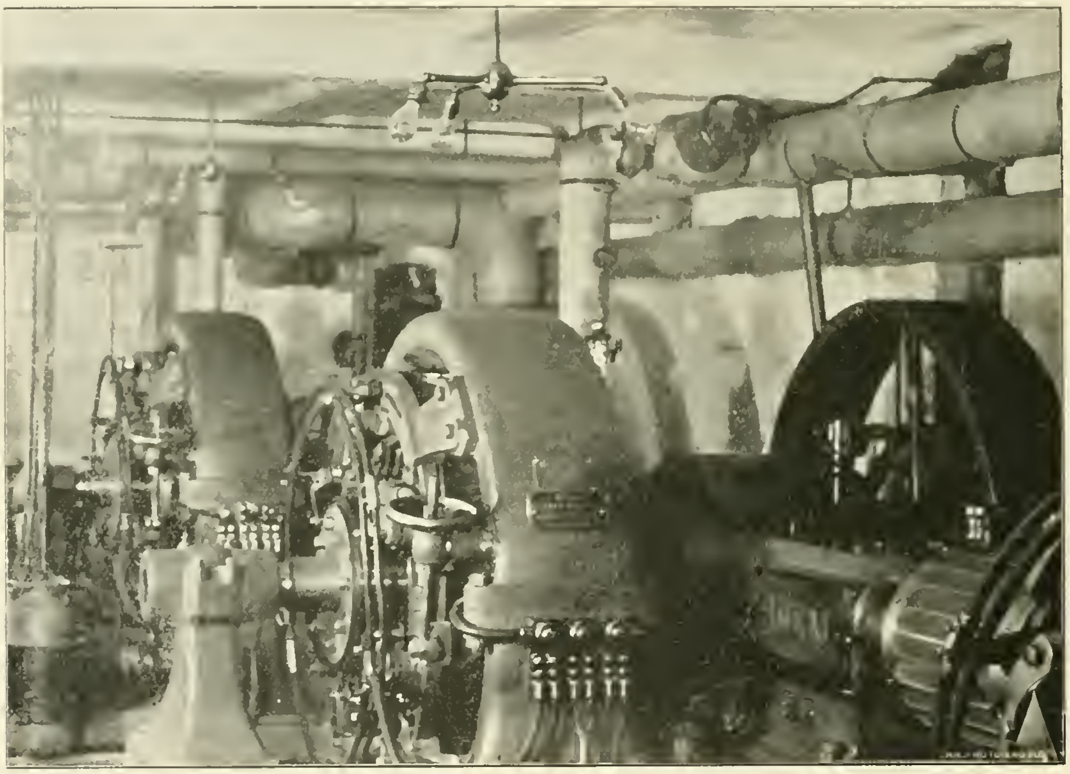
A meeting was held at Bobcaygeon, Ont., to consider the question of building an electric railway connecting Fenelon Falls, Bobcaygeon and Peterboro'. A committee was named to obtain particulars and report. Mr. W. J. Read is acting secretary.

Special illustrated articles in the January Cosmopolitan are: "The Real Klondike,' by J. S. Easby-Smith; "The Great and Small of Family Trees," by A. L. Benedict, "An Island on the Georgia Coast," by John R. Van Wormer; and "Some Society Tableaux," by M. E. W. Sherwood.

Mr. A. Drouin has been appointed engineer at the city hall, Montreal, to succeed Mr. Felix Decarrie. The following persons were applicants for the position: J. O. Joly, Thomas McHugh, E. J. Hatton, N. E. Barsalou, William Morrow, A. Drouin, Alph. G. Lapointe, S. Richard, M. E. Bellevance. Mr. Drouin has been in the service of the corporation for eight years and is attached at No. 10 station. He has a certificate of inspector of boilers and was formerly attached to the steamer Miramichi. For five years he has been president of the French section of the Stationary Engineers. The present assistant, William Morrow, has been permanently appointed on the staff.

STEAM AND ELECTRIC PLANT AT THE FORESTERS' TEMPLE.

Perhaps the largest isolated lighting plant yet installed in an office building in this country has recently been completed at the new Foresters' Temple, corner Bay and Richmond streets, Toronto. This building is one of the most modern in Canada, is ten stories in height, with a frontage of 96 feet on Bay street and 132 feet on Richmond street. In keeping with the general high-class character of the building is the steam and electric plant, an inspection of which was made by a representative of the Electrical News. The general arrangement of the plant is such as to insure the greatest convenience and economy of operation, the apparatus being of the most improved type and reflecting credit alike upon the owners, architect and contractors. From a brief outline of the installation some points of interest and instruction may be gathered.



Electric Light Plant, Foresters' Temple, Toronto.—View of Generators.

The boiler room, located in the southern portion of the basement and beneath the Richmond street sidewalk, is oblong in shape, being about sixteen feet wide and extending nearly the total length of the frontage, some 130 feet. Luxfer prisms in the sidewalk provide the required light, thus removing the necessity of artificial lighting. The battery consists of two Heine boilers of 120 horse power each, manufactured by the Canadian Heine Boiler Company. Instead of being placed side by side as is usually the case, these boilers are set in line, the arrangement bringing the fuel door of each boiler in close proximity to the coal bunkers, of which there are two, one at each end of the boiler room. The boilers are guaranteed at 50 per cent. above rated capacity, and are fitted with two Jones' Underfeed Mechanical Stokers, built by the Weeks-Eldred Company. In connection with these stokers is one of McDonough's electric damper and pressure regulators, working on a quick opening valve on steam line, connected to a six horse power engine driving a No. 7 Sturtevant fan forcing air into the furnace, and so arranged that when steam is at 90 lbs. the engine is cut down and simply kept moving by a by-pass. This device simply permits sufficient steam to enter to keep the engine off the centre. The Sturtevant fan and 6 h. p. engine was also supplied by the Weeks-Eldred Company. The belt connecting same, furnished by the A. R. Williams Machinery Co., is laced with wire, making it appear endless. The fan also draws air from the boiler room, ventilating this room and supplying the furnace with air.

Coal screenings are used for fuel. These are unloaded direct from the wagon to the storing bins and conveyed to the furnaces by means of a trolley, the track extending from one end of the boiler room to the other, with switches, Mr. R. L. McIntyre, of Toronto, being the builder. An hydraulic hoist provides a convenient means of disposing of the ashes. This hoist can be drawn about 3 feet 6 inches above the sidewalk, thus placing it on a level with the wagon and rendering loading and unloading comparatively easy.

Passing to the generating room, 50 x 32 feet in size, with concrete floor, we first reach the electric generators and engines, the contract for which was completed in a highly satisfactory manner by the W. A. Johnson Electric Company, of Toronto. Three direct current 50 kilowatt Walker generators, for which the above company are Canadian representatives, are direct connected to "Ideal" engines, 12 x 12, the latter manufactured by the Goldie & McCulloch Company, of Galt. One of these generators is wound for 250 volts, is running at 275 revolutions per minute, and is supplying current for motors and electric elevators. The motors drive the fans for ventilating purposes, and will also be required for other power service. The other two generators are wound for 125 volts, and are furnishing current for electric lighting throughout the building, which is wired for a capacity of 2,800 16 c. p. lights. In addition to these generators there is a motor generator of 80 lights capacity, built at the works of the W. A. Johnson Electric Co. This machine takes current from the power generator and supplies lighting during the day-time. This portion of the installation has many points of merit, the three direct connected generators only occupying a space of about 12 by 33 feet. The economy in space by means of the direct connected generators is a great consideration in plants of this character, and should result in the almost universal adoption of this type of machine. The running of the engines and dynamos is practically noiseless, and not a spark can be seen on the generators. They are also perfectly dry, and persons can place their hands on any part without feeling the least current. The carbon brushes are provided with a new patent brush holder, which permits of proper regulation in a simple manner. No adjustment of brush swivel is necessary for changes of load on dynamos. The above machines have a greater capacity than those of any other isolated plant in an office building in Canada.

The switchboard and wiring were contracted for by the Bennett & Wright Company, and are most complete. The switchboard is arranged so that the entire lighting and power service in the building will be controlled by the switches mounted thereon. It is constructed of white Italian marble on an iron frame, 15 feet 6 inches in length by 7 feet high. The board is set 2 feet 6 inches out from the wall, and all connections made at the rear. There are seven panels in all, six being provided for switches and a seventh for pressure gauges, pneumatic clock and Paul system jets. Of the six panels referred to three are provided for the generator, each having double pole main switch, field rheostat and Weston volt and ammeter. One panel has the four power service switches for elevators and other motors, and two double throw main switches, by means of which the entire lighting and power service may be thrown instantly from the generators before mentioned to the Toronto Incandescent Company's service, or vice versa. The other two panels contain the lighting service switches for the building, of which there are thirty-six. All the switches except for equalizer are double pole and have fuse terminals.

The wiring throughout the building is most secure, Habershaw wire in iron-armoured conduits having been used. The wires are continuous and always accessible, and can be drawn out and replaced at any time. The distributing circuits throughout are connected to slate tablet boards, no porcelain cut-outs being used.

Next we come to two boiler feed duplex pumps, 7½ × 4½ × 10, made by the Northey Mfg. Company. An Excelsior feed water heater, purifier, filter and oil separator is located near these pumps, and is a device especially worthy of mention. It is manufactured by the Excelsior Heater Company, of Chicago, and was installed by the Bennett & Wright Company. A few words of explanation may here be required, as it is claimed that this is only the second machine of the kind to be introduced in Canada, the other one being in the new municipal buildings in Toronto. The building is heated by the exhaust steam from the engines by the one pipe overhead system. When the steam reaches the separator, all the oil and grease is exhausted therefrom, and it passes to the heating mains and is supplemented through a pressure reducing valve with live steam as required. The condensed water returns to the heater, is pumped back to boilers and used over again. By this arrangement it is possible to exhaust into the heating system or direct into the atmosphere. The pumps work automatically by float attached to quick-opening valve.

Another interesting feature of the plant is a duplex air pump, made by the Johnson Electric Service Company, of Milwaukee, its purpose being to pump air to control the diaphram air in the radiators. There is also a water plunger pump for same purpose, to be used as an auxiliary, and two air storage tanks in connection therewith attached to the ceiling. The steam pump works automatically by a governor. To provide ample fire protection is an underwriters' fire pump, 14 × 7 × 12, built by the Northey Mfg. Co., and of a capacity of 500 gallons per minute at a pressure of 250 pounds to the square inch. A twelve-ton ice machine built by the Buffalo Refrigerator Co., and used for cooling air for ventilating purposes, a Tobey water heater supplying hot water to all lavatories throughout the building, and a Westinghouse air pump for operating the pneumatic gates on elevator enclosures, are other interesting features of the plant. These pneumatic gates are splendid safety devices, it being impossible to open them excepting when the elevator is level with the floors, and then all that is required is to simply touch a button. In the building are three Standard elevators, which run on the low amperage of 50 amperes at full load. The easy motion in starting and stopping and the smooth running of these elevators is the subject of comment by passengers. A novel device in connection with them is an indicator, which indicates to passengers desiring to ascend or descend just where the elevator is, and whether it is going up or down.

The two boilers are connected by a four-inch pipe, and extending from this connection to the engine is a six-inch pipe. The distributing pipe for the heating system is twelve inches in diameter, and from it the various riser pipes are taken. The steam pipes are protected by mineral wool from the works of the Toronto Mineral Wool Company. The exhaust pipes are placed under the floor, with removable metal plates covering them.

Adjoining the engine room is the supply and repair department, 50 × 20 feet, well equipped with cupboards for storing electric lamps, tools and general supplies, oil tanks, pipe racks, drawers for fittings, etc. The space devoted for this purpose permits of everything being arranged in the best possible manner.

The complete electric and steam apparatus and fixtures, excepting the dynamos and engines, were contracted for by the Bennett & Wright Company, who are among the foremost experts in their line in Canada. Mr. T. F. Pickett, foreman electrician for the company, had charge of installing the electric fixtures throughout, including switchboard and wiring, and nothing more than an inspection of the work is required to convince one of its thoroughness.

Mr. G. A. Wilkie is chief engineer, and upon him devolves the duties of the mechanical superintendence of the building. In Mr. D. A. Dixon he has a valuable assistant. To these gentlemen the writer is indebted for courtesies extended while obtaining the above description.

Mr. R. Mackie has been appointed chief engineer of the new sewage disposal works at Hamilton. Mr. Mackie holds a first-class certificate, and has been engineer at the Hamilton Bridge and Tool Works, Copp Bros., and the Rolling Mills.

The Shawenegan Manufacturing Company has asked for letters-patent of incorporation, with a capital of $500,000. Its object is to develop the water power of the St. Maurice river, in the province of Quebec, for the production of calcium carbide and electricity. Among the promoters are Peter Lyall, contractor, Montreal, and Charles Riordon, paper manufacturer, St. Catharnes.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By Wm. Thomson.

INTRODUCTION.

In introducing the above subject to the readers of the Canadian Electrical News, I do so with a great deal of pleasure. Generally speaking, no branch of steam engineering receives less intelligent attention on the part of steam users and engineers than does this most important subject. The great importance of the subject itself is but vaguely understood, and the attention it generally receives is of a kind that in the interests of either economy, safety or science, might be very easily dispensed with.

It has been my privilege during the last few months to have handed to me samples of feed water and boiler scale from every part of this Dominion. An examination of these proves to me the great necessity of the whole subject being discussed in a thorough manner.

I do not hope to add any new scientific facts on this subject, but rather to make present well-known facts plain to my readers. For this reason I shall endeavor to confine myself to the four general headings :

1st. The presence of corrosive agents in feed waters—their nature and action on the boiler plates.

2nd. Scale-forming agents and nature of scale formed by different materials.

3rd. Combined action of scale-forming and corrosive agents.

4th. Reaction necessary to prevent the formation of scale.

This covers an immense field, and entails a lot of labor, which I cheerfully undertake for the mutual benefit of myself and fellow engineers, my only cause for regret being that a more able Canadian engineer has not seen fit to undertake the task.

I have to thank those of you who so kindly placed feed water and scale at my disposal, and sincerely hope that a perusal of these articles will amply repay you for any trouble you have taken in this respect.

Very truly yours,

The Author.

[Article 1.]

Water is universally conceded to be the greatest of all known solvents, consequently it never occurs in a state of purity as a natural supply. The foreign matter may be composed of either solids or gases, or both, and may be in suspension, mechanical or chemical solution with the water. By the term suspension is meant a state in which the foreign matter is present in the water in its original state, no matter how finely divided, and when it can be abstracted from the water by filtration, having the same properties as when it entered the water in the first place.

In boiler feed waters this usually consists of vegetable organic matter, finely divided clay, etc. The coarser and heavier the particles the sooner will they separate out and settle to the bottom of any receptacle in which water may be contained. It is possible, however, to find water with foreign matter in suspension so minutely divided that it is impossible to detect them except by slight turbidity or characteristic coloring given to the water. I have in my laboratory samples of water taken from freshly drilled artesian wells in the vicinity of Montreal, containing particles of clay held in suspension so minutely divided that it took weeks for complete settlement to take place, and the slightest movement of the containing vessels would cause particles to again rise in the water, thus causing turbidity.

Matter in mechanical or physical solution, on the other hand, has entered into combination with the water and cannot be again abstracted except by means of a change of state or evaporation. For instance, to pure, distilled water add common salt ; this at once dissolves, and until water is saturated, if salt was pure, no apparent change takes place in the appearance of the water itself, and if solution was passed through the finest possible filter, salt would still remain in solution, but if we carefully evaporate off the water, salt will finally remain in its original state, no evident change having taken place.

If to pure water (H_2O) we add oxide of sodium (Na_2O), soda at once combines with the water, or part of it, with generation of heat, a chemical reaction taking place in accordance with following equation :

$$Na_2O + H_2O = 2NaOH.$$

In this case one molecule of sodium oxide enters into combination with one molecule of water to form the new chemical compound, sodium hydro-oxide, which dissolves in the excess of water present, and remains in chemical solution ; and if water was evaporated off, sodium oxide would not be recovered in its original state as an oxide, but in the state of sodium hydroxide.

The reader will note the difference here. On the one hand, addition of sodium chloride to the water made no apparent change in general appearance of water to the naked eye, and no heat was evolved, and on evaporation it was again recovered in its original state, and without any change in weight. In this case salt simply entered into mechanical solution with the water, due to the solvent powers of that menstrum, and is really but a physical change. In the other case, sodium oxide first entered into chemical combination with a portion of the water (due to the chemical affinity of the one compound for the other) with evolution of heat, and excess of water present dissolved new chemical compound, which then remained in chemical solution. On evaporation solid sodium oxide would be found to have gained in weight in direct proportion with the number of molecules of water required for chemical change from the oxide to the hydroxide.

Changes of this description are constantly taking place, and it is with these we shall particularly deal at a later stage in these articles.

Not only do a great many solids dissolve in water to a greater or less extent, but many gases also dissolve very readily, and to these can be traced phenomenon occurring in some feed waters known as pitting corrosion and grooving.

The first of these may be very properly described as corrosion, occurring in small spots on parts of a boiler, and is quite distinct from general corrosion, which wastes away an extended area of surface. Pitting is both annoying and generally very destructive, in some cases burrowing holes through the affected parts of a boiler as completely as if it had been drilled. This action was formerly and is to-day occasionally attributed to poor material used in construction, the theory being that weak spots exist and are attacked by corrosive agents found in the material itself. There remains practically no doubt but that a condition of affairs of this kind existing would have an effect on the boiler parts, and would facilitate the pitting action. An explanation of this kind falls very far short of a satisfactory answer, however, in either theory or practice, as it is applicable to very few cases.

Careful experiments made by leading chemists and a review of the whole subject go to prove quite conclusively that pitting occurs most frequently when gases are found dissolved in the water, oxygen and carbonic acid gas being the most active agents, and more especially when present together. These gases under certain conditions are very soluble in water, and in examining a water for boiler feed purposes require just as careful consideration as does dissolved solid.

Atmospheric air dissolves in water very readily, and contains at all times a certain percentage of carbonic dioxide, and here a very peculiar fact is to be noted that has an important bearing on the point before us. It is a well known fact that atmospheric air is composed of nitrogen and oxygen in mechanical combination, four of nitrogen to one of oxygen by volume, or very nearly 79 volumes of nitrogen to 21 of oxygen. When atmospheric air is dissolved in water these proportions are found to have changed, said to be due to the greater solubility of oxygen in water.

It is worthy of note that water dissolves very unequal quantities of the different gases, and very unequal quantities of the SAME GAS, at different temperatures. One volume of water absorbs at the temperatures stated in the following table under atmospheric pressure equal to 30 inches of mercury, according to Bunsen, the following volumes of the different gases :

Degrees. Fah.	Oxygen. (O)	Nitrogen. (N)	Hydrogen (H)	Carbon Dioxide. CO_2	Chlorine. Cl	Sulphur Dioxide. SO_2	Hydric Chloride. H Cl
32°	.041	.020	.019	1.80		53.9	505
50°	.033	.016	.019	1.18	2.59	36.4	472
68°	.028	.014	.019	.90	2.16	27.3	441

While not altogether applicable to our point, it may be stated that as the pressure increases a correspondingly larger quantity of the gas is absorbed, and as the temperature increases the solubility of the gas decreases in many cases. (Carefully refer to table on this point.) It is, however, important to note that the pressure which determines the rate of absorption of a gas is not the general pressure to which the water or other absorbing liquid is exposed, but that pressure which the gas under consideration would exert if it were ALONE PRESENT in the space in which the absorbing liquid is in contact. It is necessary to bear this in mind to understand why atmospheric air absorbed by water differs in composition from ordinary air.

As I have said, atmospheric air consists of 79 parts of nitrogen and 21 parts of oxygen. In atmospheric air, acting under a pressure of 30 inches of mercury or one atmosphere, the oxygen exerts a partial pressure of $\frac{21}{100}$, and the nitrogen $\frac{79}{100}$. At 50 F, according to table, one volume of water at atmospheric pressure absorbs .033 volume oxygen and .016 volume nitrogen, supposing these gases to be in a pure state. Then under the partial pressures above indicated water cannot absorb at 50° F. more than $\frac{21}{100}$ x .033 = .007 volumes of oxygen and $\frac{79}{100}$ x .016 = .013 volumes of nitrogen.

Then, in .007 + .013 = .020 volumes of atmospheric air absorbed by water there are consequently .007 oxygen and .013 nitrogen, or in 100 volumes, 35 volumes of oxygen and 65 volumes of nitrogen. Atmospheric air then dissolved in water is seen to be very much richer in oxygen than is the air itself in its ordinary condition. This fact is in itself worthy of the most careful consideration, and explains clearly what is too often considered purely accidental phenomena.

Before proceeding to discuss what action takes place during the act of pitting, I wish to digress from the subject to point out to the reader that the capacity of water to absorb gases of fixed chemicial compounds, such as carbonic dioxide (CO_2), sulphur dioxide (SO_2), and hydric chloride (HCl), must not be confounded with the behavior of atmospheric air. Thus hydric chloride must not be understood as being absorbed by water in the same proportions as its elements, hydrogen and chlorine. It is a complete gaseous chemical compound of itself, and combines as such; in other words, nitrogen and oxygen retain their own peculiar properties in atmospheric air, but just as soon as hydrogen and chlorine combine together to form hydric chloride, an entirely new chemical compound is formed, with quite different properties from the elements of which it is composed, and with entirely different degrees of solubility.

When water is strongly heated for a long time, atmospheric air is completely expelled, and at once resumes its normal composition; thus we have present a quantity of free oxygen, which is the cause of a great deal of our trouble. While the action of oxygen on iron is well understood, it is not easy to explain the action of gases producing pitting in a steam boiler, particularly to explain why isolated spots are attacked while surrounding metal remains unaffected. If we heat water gradually in a glass retort, open to the atmosphere, bubbles of gas or air expelled from the water are seen clinging to the sides and bottom; and if we purposely scratch the inner surface of the glass, or in other manner create an imperfection of a similar nature, it presents a wonderful attraction for these little bubbles, more collecting there than at any other part of the retort. And so tenaciously do these bubbles cling to their selected places that it requires considerable agitation to remove them.

In steam boilers the same conditions prevail, and there remains but little doubt that these bubbles contain free oxygen and other gases in a favorable condition to act on the metal beneath. Temperature being high, they necessarily act with a great deal of rapidity. When the oxygen has combined with the iron of the metal, protoxide of iron (FeO) is formed, and a little excresence appears on the surface of the metal, due to the expansion of the iron by the addition of oxygen, and occupying more space than the iron acted upon. Subsequent expansion and contraction causes this small excresence to burst, and leaves a small pit or roughened surface, which readily attracts the gas bubbles, and the process is again repeated until finally a hole has been eaten a considerable distance into or completely through the part affected.

(To be Continued)

NEW ARC LAMP.

THE accompanying cut represents a new type of arc lamp recently placed on the market by the Canadian General Electric Company. This company announce that they are now prepared to furnish a satisfactory and economical arc lamp for constant potential, alternating current circuits. The problem is said to have been a difficult one to solve, but the results obtained are claimed to be such as to warrant any apparent delay.

The principal features of the new lamp are briefly as follows: Small maintenance account, by reason of a life of 60 to 70 hours, with one pair of carbons; the lamp is simple in construction, has few moving parts and operates quietly; great economy, ninety-three per cent. (93%) of the energy being utilized in the arc; operates independently on circuits of 100 to 120 volts, and frequencies of 60 or 125 cycles.

The lamp requires 70 volts potential to the arc, and consumes six amperes. The difference in the potential at the arc and at the terminals is taken up by an inductive resistance, which is the unique feature of the lamp. This inductive coil does not consume in excess of 25 watts, and is placed within the interior of the ornamentation. The use of high grade carbons is essential. The lamp is artistic in appearance and especially suitable for interior illumination. The ornamentation is finished in ground brass and black enamel. The company are also prepared to furnish a weatherproof lamp suitable for outside service.

C. G. E. Company's New Arc Lamp.

The renowned LeRoi Mines of Rossland, B. C., are extending their pumping system, and have placed an order through the Rossland branch of the Jenckes Machine Co., Sherbrooke, Que. for a large size special Knowles sinking pump.

CANADIAN
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AND
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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Operation of Street Car Motors.

FEW street railway managers are aware of the importance of teaching their motormen to economize power by an intelligent handling of their controllers. The controller is intended to take the place of the old method of slowly accelerating cars, and of avoiding a rush of current through the motor when at rest, and instead of simply interposing a resistance in series with the motor which can be gradually cut out, it so arranges the armature and field coils of two motor cars as that they are all placed in series with each other at the start, so that each motor actually has then a difference of pressure of about 250 volts across its terminals, without their having been any useless consumption of power in a rheostat. The idea of this is, of course, in order that there may not be a sudden rush of current through the motor, which would be the case if it were subjected, when at rest, to a pressure of 500 volts. When it has accelerated to some extent, then a second step of the controller throws each motor in parallel with its own fields, but in series with the other motor, which combination reduces the total resistance and more current flows, until finally, after the successive steps of the controller have been finished, both motors are in series with their own fields and in parallel with each other, each one taking the full 500 volts. A speed regulation is also often effected by manipulating the controller, it being kept at some intermediate position when it is desired to run slowly, or creep up to some stopping point. Any position, however, except the last, that is, the motors in series with their fields and in parallel with each other, causes the motors to work at very low efficiency, and should be avoided as much as possible. If it be desired to go slowly it is better to open the controller full for a few moments periodically and then shut it right off, "drifting" until the speed becomes too low, and then opening full again and so on, rather than to run at any intermediate point. A little practice will soon enable an intelligent motorman to run slowly and smoothly. It is also preferable to use a break strongly to stop, than to slow down by intermediate steps.

The Chambly Power Plant.

A NUMBER of prominent persons last week made an inspection of the works of the Chambly Manufacturing Company, now in course of construction at Chambly, Que., and a description of which appeared in the ELECTRICAL NEWS for December last. The party included Mr. F. S. Pierson, chief engineer of the Metropolitan Traction Company, of New York, and several officers and directors of the Montreal Street Railway Company. A thorough examination of the entire plant was made, and the unanimous expression was that the works were of the highest possible character. This opinion from an expert such as Mr. Pierson must be a source of gratification alike to the promoters of the undertaking and the citizens of Montreal and vicinity, who will be consumers of the current.

Guaranteeing Street Railway Bonds.

A BILL has passed the Ontario Legislature which is regarded as being somewhat of an innovation. It provides that the city of St. Thomas shall guarantee the Street Railway Company's bonds to the amount of $50,000, to enable the company to electrify its street railway system. In the event of the company failing to keep up its payments on the bonds, the city is permitted to take over the road and operate it. Hon. Mr. Gibson, in referring to the bill, stated that the provision for municipal operation was something that had never been introduced in the Legislature before, but he believed that in the modern view such powers were proper ones to bestow upon the municipality.

Decision as to Smoke Consumers.

A BY-LAW of the city of Montreal provides that steam users must equip their plants with proper apparatus for consuming the smoke. An action was recently entered in the Recorder's Court by the Boiler Inspector against a saw-mill owner for not complying with the provisions of the law. The defendant contended that residents in the vicinity had entered no complaint, and that, owing to an increase in the height of the chimney, no nuisance now existed. The court, however, decided against the defendant, pointing out that according to law every steam user was obliged to provide smoke consuming apparatus, and no complaint from the neighbors was necessary. The decision was looked forward to with much interest, as a number of similar cases were pending at the time, which were subsequently dealt with in a like manner, the Recorder allowing eight days in which to provide the apparatus. It is claimed that in the city of Montreal ninety-seven factories are equipped with means of consuming the smoke, while perhaps five times that number of establishments contain steam boilers. It is quite probable that action will be taken to compel every steam user to comply with the law, in which case the manufacturers of smoke consumers will reap a harvest. In Toronto the law in this respect differs from that in Montreal, inasmuch as only when the smoke from a factory can be shown to be offensive or destructful are steam users compelled to provide a remedy. A number of the largest manufacturers, however, have found it profitable to equip their plants with mechanical stokers, which besides effecting a large saving in fuel, also remove the necessity of providing smoke consumers, owing to the method of firing employed. As the number of steam plants in Toronto and other large cities becomes greater, it may be found necessary to adopt regulations such as those in force in Montreal.

Electric Cabs vs. Street Railways.

MR. A. H. St. Germain, of North Toronto, has announced his intention of organizing an autocar service between York Mills and the city of Toronto. He is said to have ordered three electric busses from an English firm, to be delivered early in the spring. This service will come in direct competition with the Metropolitan Street Railway, and may also affect the receipts of the Toronto Railway Company. The success of the venture will therefore be watched with more than usual interest. The electric cabs will be entirely different from any heretofore seen in Canada, and will have a carrying capacity for thirty passengers, which would seem to strengthen the probability of their successful competition with street railways. In London, England, these cabs are becoming a familiar sight, and are believed to have passed the experimental stage so far as energy is concerned, but the cost of the maintenance of the battery is a point that has not as yet been demonstrated. While not forecasting any serious loss of revenue to the street railways effected, the proposition made by Mr. St. Germain is doubtless of some interest to street railway companies as showing what may be attempted at other places under similar circumstances. The reason for Mr. St. Germain's decision to inaugurate such a service is probably to be found in the present unsatisfactory means of reaching the central part of Toronto from points on Yonge street adjacent to the city, it being necessary to transfer from the cars of the Metropolitan Street Railway to those of the city line, and also to pay an additional fare. It will be remembered that at the last session of the Ontario Legislature the Metropolitan Railway Company sought to obtain running rights over the Toronto Railway Company's track to the Union Station, but the application was refused for the reason that the two companies could not come to an agreement as to terms. Had such an arrangement been made, probably nothing would have been heard of the proposition to run a system of autocars. The interests of both railway companies and municipalities would, we believe, be best conserved by the appointment of a Board of Arbitrators to decide the question of running rights of one railway over the tracks of another, and to fix the rates of fares and matters of this character.

ELECTRICAL EXPOSITION IN 1898.

A COMPANY of New York gentlemen has been formed, with a capital of $20,000, to conduct an electrical exhibition in that city some time during the present year, to follow the line of the show held in May, 1896, and which was a pronounced success. Mr. Marcus Nathan has been chosen as general manager. The new electrical inventions and improvements developed within the past two years will be an important factor, and it is hoped to greatly surpass the former effort.

The bill permitting the city of St. Thomas, Ont., to guarantee the bonds of the Electric Street Railway Company to the extent of $50,000, has been passed by the Private Bills Committee of the Ontario Legislature.

MR. ALFRED T. SMITH.

Presented herewith is the portrait of a gentleman well known in telephone circles, Mr. Alfred T. Smith, District Manager for the Bell Telephone Co., with headquarters at Kingston. Mr. Smith has just emerged from a serious illness, covering a period of more than two months. His friends will be glad to learn that although a month ago he was declared by the physicians to be beyond recovery, his excellent constitution enabled him to withstand the ravages of disease, and he is to-day out of danger and on the road to convalescence. A few weeks spent in a milder climate will, it is hoped, be the means of completely restoring him to health again.

Mr. Alfred T. Smith.

Mr. Smith has been in the employ of the Bell Telephone Company for nearly twenty years, having entered their service at Hamilton in the year 1879, when 18 years of age. One year later found him in charge of construction, and the following year he built the first long distance telephone line in Canada, connecting the cities of Toronto and Hamilton. His ability and careful attention to business led to his appointment in January, 1882, as local agent for Peterborough and Lindsay; from thence he was transferred to the Halifax agency in August, 1884. While in charge of this district the telephone system was installed on Sable Island much to the convenience and comfort of the guards. The electric light system of Halifax was also constructed under his immediate supervision. In 1886, at his own request, Mr. Smith was transferred to the Kingston agency, and in May, 1897, his faithful services were further recognized by his appointment as District Deputy of the Ontario Department. He is a brother of Mr. A. B. Smith, superintendent of construction for the G. N. W. Telegraph Company.

THE LATE WILLIAM BELL.

Early in December death removed ex-Alderman William Bell, Dominion government engineer, and possibly one of the best known men in Toronto. His illness was of a lingering nature, an attack of typhoid fever subsequently developing into jaundice. Deceased was 61 years of age. He was born in Woolwich, England, in 1836, and came to Canada when quite young. He settled first in Montreal, and came to Toronto in 1857, since which time he had gradually become a prominent figure in municipal and political life, serving as a member of the School Board and City Council. For four years he held the position of tax collector. In 1890 the late Mr. Bell stood as an equal rights candidate in the provincial elections, but was unsuccessful. In 1894 his services were recognized by his appointment as government engineer at the Customs House in Toronto. Ever since 1854 Mr. Bell was connected with the Orange Lodge, having been County Master for two years. He was also a member of St. George's Masonic Lodge and of the Sons of England.

MUNICIPAL LIGHTING PLANT AT MAGOG, QUEBEC.

The turning on of the power and light in connection with the new municipal lighting plant at Magog, Que., was made the occasion of a reception given by the mayor and councillors in the opera house. The hall was brilliantly lighted by many incandescent lamps, and the whole town turned out. Speeches were made by Mayor Bessette and other councillors, and a very pleasant evening was spent. Magog is one of the first towns in the eastern townships to adopt, own and operate its own lighting plant. The power is obtained from the Magog river, just below the cotton mills. The water wheel plant of the Crocker special type was furnished by the Jenckes Machine Company, of Sherbrooke, Que., and the generator, wiring and electrical plant by the Canadian General Electric Company.

The town have under consideration the control of the water works, with a view of locating a pumping station alongside the lighting plant, as plenty of power is available for this purpose.

BELL TELEPHONE COMPANY'S ASSESSMENT.

Judge Snider has given a written judgment in the assessment appeal of the Bell Telephone Company at Hamilton. The company was assessed for $27,200 on land and buildings, $24,700 on poles, wires, etc., $5,000 income and $21,600 personalty, on instruments, etc. The assessment on land and buildings was reduced to $17,000, the income and personalty assessment was struck off, and the assessment on the poles, wires, etc., was reduced to $13,940, the value of the poles, etc., in Ward 2. The judges held that the poles, wires and conduits were assessable as real estate, but the way the assessment was made they could only assess the poles, etc., in Ward 2. The judges held that the telephone instruments were personal property, and that under the act the company was not assessable for personalty. It was held that a reduction should be made for the cross-arms used by the city for fire alarm purposes, and that no agreement existed between the city and the company in reference to the aseessment. The judges considered that the assessment should be made as a "going concern," and that the poles, etc., should be assessed up to 85 per cent. of the cost. While the assessment was reduced from $78,500 to $30,900, it is only $2,200 less than last year. The judges decided in favor of the principle of assessing poles, etc., as real estate, and would have allowed the whole amount had the assessment been divided among the different Wards and not all in Ward 2.

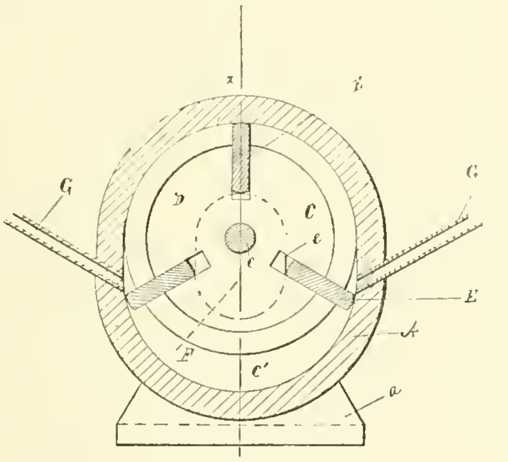
APPRECIATES IT HIGHLY.

Mr. Roderick J. Parke, electrical engineer, Montreal, writes: "I am a regular subscriber to the Electrical News, and appreciate it highly—in fact, I would not be without it for triple its cost."

RECENT CANADIAN PATENTS.

THE Patent Record contains descriptions of the following devices, for which patents have been granted in Canada :

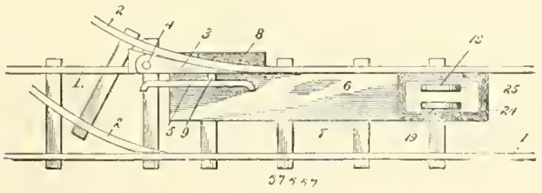
Steam engine indicator, Peter E. Apgar, Philadelphia, Pa.; smoke consumer, Chas. C. Bruckner, Chicago; apparatus for utilizing exhaust steam, Herman Ten Winkel, Denver, Col.; car brake for street railway, Patrick Flood, New York; gas engine, W. E. White and E. A. Myers, Garnett, Indiana; gas engine, Mexwell, Wyeth & Co., Brooklyn, N. Y.; motor vehicle, Charles H. Barrows, Williamantic, Conn.; apparatus for attaching electric lamp bulbs, Olney Smith, Detroit, Mich.; rotary engine, Charles A. Ingerham, Wabigoon, Ont.; smoke consumer, J. H. Saunders, Buffalo, N.Y.; meter, Canadian General Electric Co., Toronto; system of electrical transportation, Philip K. Stern, St. Louis, U. S.; system of electrical distribution, Canadian General Electric Co., Toronto; electric meter, Canadian General Electric Co., Toronto; motor reversing switch, Canadian General Electric Co., Toronto; grate for steam boilers, Alfred Davy and John Edey, London, Eng.; armature, Abe L. Cushman, Concord, U. S.; valve indicator, John T. Christie, Troy, N.Y.; storage battery, Lee & Co., Chicago; trolley wheel, R. I. McPhail, Toronto; system of electrical distribution, J. F. Kelly and C. C. Chesney, Pittsfield, Mass.; speed gear for motor cars, George G. Hardingham, London, Eng.; smoke consuming apparatus, Michel E. Bernier, Montreal; governor for steam engines, Edwin J. Armstrong, Oswego, N.Y.



ROTARY ENGINE.

Patentee : Walter F. Clements, Winnipeg, Man., granted 17th September, 1897.

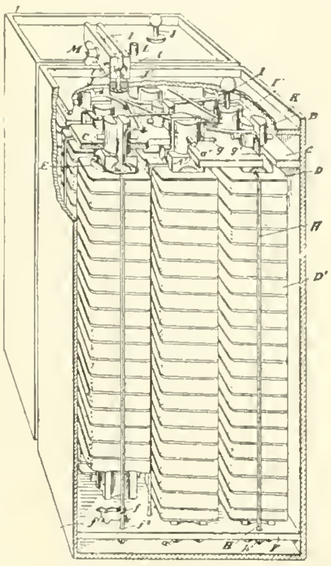
Claim.—In a rotary engine, the combination with a cylinder eccentric in cross-section, of a revoluble piston bearing against one side of the cylinder and forming a steam chamber on the other side, said piston being provided with radial slots and recesses in its sides, stationary cams arranged inside the said recesses with their peripheries concentric with the periphery of the cylinder, and abutment plates slidable in the said radial slots between the said cams and cylinder, substantially as set forth.



STREET RAILWAY SWITCH.

Patentee : Wm. A. Grant, assignee of Filmore Peters, both of Cornwall, Ont., granted 23rd September, 1897.

Claim.—In an automatic switch, the combination with an operating lever connected to a switch-tongue, of mechanism adapted to actuate the lever when operated by devices carried by a car. The combination of an operating lever arranged beneath the surface of the track, operating cams provided with bevelled surfaces, a friction-reducing device, and means for depressing the cams. An automatic switch comprising a box, a covering-plate therefor, an operating lever pivotted to the under side of said covering-plate and working within said box, said operating lever being suitably connected to a switch-tongue, an anti-friction roller carried by the operating lever, a series of operating cams pivotted adjacent to said lever and provided with bevelled surfaces adapted to contact with said anti-friction roller for shifting the lever, means for returning the cams to their normal position and for assisting movement of the operating lever, in combination with a series of swinging arms carried by a car, a series of cam-levers also carried by the car, and suitable connections between said cam-levers and the swinging arms, the latter being adapted to contact with the operating cams for shifting the switch.



STORAGE BATTERY.

Patentee : Charles Riordon, assignee of Wm. J. Still, both of Toronto ; granted 23rd October, 1897.

Claim.—In a storage battery, an electrode, comprising a rectangular, hollow spiral of flat strip sheet lead in flexible form with both edges free, an interposed hollow spiral of active material, exposed at the inside and outside, a rectangular supporting post for the electrode extending up through the spiral longitudinal grooves in each side of the post, and a lead from the centre edge of the spiral extending up through one of the grooves through the central opening of the spiral. The combination with the spirally formed electrodes, having the reduced top and bottom ends forming shoulders, of the top and bottom plates, slots in the same through which the leads extend, binding posts to which the leads are connected, and the top sealing plate resting on the tops of the posts and having openings through which the binding posts extend. The combination with the electrodes and leads therefrom, and binding posts to which the leads for each cell are connected, having stems with spherical heads, of a pair of connecting plates for the cells having arc-shaped grooves and clamping means for holding the spherical heads in the grooves, as and for the purpose specified.

PERSONAL.

At a meeting of the board of directors of the Niagara Falls Park and River Railway, held in Toronto, Mr. Wilfred Phillips, who had completed his first year as acting manager of the road, was appointed general manager.

Prof. Alexander Melville Bell, of New York, the distinguished scientist and father of Mr. Graham Bell, the inventor of the telephone, has chosen a Canadian lady as a partner in life, in the person of Mrs. H. G. Shibley, of Harrowsmith, Ont.

Mr. R. C. Pettigrew, of Hamilton, treasurer of the Executive Council of the Canadian Association of Stationary Engineers, was elected alderman for the Seventh Ward at the municipal elections this month. Mr. Pettigrew was formerly a member of the School Board.

Mr. T. R. Rosebrugh, lecturer in electrical engineering at the School of Practical Science, Toronto, was married on the 30th of December last, at Syracuse, N.Y., to Miss Jessie Aeolia Whyborn, only daughter of Dr. Whyborn, of that city, the ceremony being performed by Rev. R. Calthrop. The ELECTRICAL NEWS joins with the many friends of the bride and groom in wishing them many years of wedded happiness.

Mr. Walter Rogers, brother of Mr. Joseph Rogers, of the Rogers Electric Company, died at St. Joseph's Hospital in London last month, after an illness of a couple of months. Deceased was an electrical construction man of wide experience and exceptional ability. Before going into business with his brother he spent two years at electrical work in Vancouver, B.C., for the Vancouver Street Railway, and one year in Chicago with the Edison Electrical Construction Company.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note. Secretaries of Associations are requested to forward matter for publication in this Department not later than the 25th of each month.

TORONTO NO. 1.

At a meeting of Toronto No. 1, held on December 15th, there was a large attendance. The trustees of the hall reported that the Queen City Insurance Company had allowed the sum of $154.71 for damages occasioned by the recent fire, which will nearly cover the the loss. A letter was read from Mr. J. J. Main, regretting his inability, owing to business engagements, to deliver a promised lecture. He hoped to be able to favor the association at a later date. Mr. Milne worked out some problems in electricity. Over fifty members were present at the regular meeting on January 5th. There was one initiation and four propositions for membership. The association was notified that the new association started in the west end of the city would hold a formal opening on Thursday evening, January 13th, to which all the members of No. 1 were invited. A committee was appointed to arrange for an At-Home to celebrate the re-opening of the hall. On Tuesday, the 11th inst., an open meeting was held, at which Mr. James Milne, manager of the Weeks-Eldred Company, delivered an interesting lecture. The regular meetings are held on the first and second Wednesdays of each month, and the president especially requests a a large attendance during the winter months.

HAMILTON NO. 2.

The above association is keeping up its standard in educational work. At a recent meeting Mr. A. M. Wickens, of Toronto No. 1, read a paper on Latent Heat, and at a later meeting a paper was presented by Mr. F. G. Mitchell, which will be found on another page.

QUESTIONS AND ANSWERS.

A correspondent sends the following as a partial answer to "Amateur" in the December issue of the News:

Absolutely correct results cannot be obtained from the diagrams, for the reasons (1) that they are not full size, and (2) they are not all to the same reduced scale. The results given below, however, will be correct for all practical purposes. In taking pipe diagrams, care should be taken to have them the same length as the others taken from the engine. When this is the case the proportions between them are exact, and when not the case the proportions must be determined by calculation. For convenience let us number the diagrams 1, 2, 3 up to 9, where 1 is the first set of exhaust cards. In comparing 1 and 3 there is a difference of 5-16 inch in their lengths, and between the first and last cards of No. 1 set there is a difference, showing that the cord must have been stretching.

We do not know exactly what is required in the nature of calculation of the exhaust cards, whether "Amateur" means to determine the point of release, etc., in terms of the stroke, or whether he desires the amount of horse power the engine exerts in working against the back pressure. We are inclined to think it is the latter, and if so this must be calculated from the other diagrams. In diagrams 3, 4, 5 and 6 we have respectively mean forward pressures of 19.6, 44, 15.4, 23 lbs., and mean backward pressures of 11.9, 9, 11.2, 9.7 lbs. respectively, giving us mean effective pressures of 7.7, 35, 4.2, 13.3 lbs., which, when calculated, gives forward horse powers of 24.6, 54, 19.3, 28.6, backward horse powers of 14.93, 11, 14, 12; the difference between the two being the resultants or indicated horse powers, which are 9.67, 43, 5.2, 16.6 respectively. It is not customary to calculate the gross forward and backward h.p., it being far easier to get the net or i. h. p. directly from the diagrams. The M.E.P. of diagrams 7, 8 and 9 are 3.9, 9.1 and 3.2 lbs., and the indicated horse powers are 7, 16.2, 56 respectively.

In the exhaust diagrams, No. 1, when measured to scale, we find that release takes place when piston is about 2¾ inches from head end of stroke and 3¾ inches from crank end. Compression commences about half-stroke.

From the above "Amateur" can draw his own conclusions regarding straight and centre connections. Probably some of the rest of your readers will answer whatever else is necessary.

M. J.

A NEW DETERMINATION OF THE VALUE OF THE OHM.

With the aim of obtaining a standard value of the unit of resistance, which value should not change with time, the machine known as the Lorenz apparatus has been developed. The British Government has adopted a standard known as the "Board of Trade Ohm Standard, Verified, 1894," which is a purely physical standard, the constancy of which, with time, depends on the assumed absence of any changes in its molecular structure or physical strains. The Lorenz apparatus, says the Electrical World, depends upon the demonstration by the dimensional system, that a resistance is proportional to a velocity, and hence can be measured by standards purely of length and time, which are less likely to change in centuries to come than the physical aggregation of the molecules of any standard resistance.

The Lorenz apparatus, as built by Messrs. Nalder Bros., of London, for the McGill University, of Montreal, consists of a bronze disc, mounted centrally on a shaft, by which it can be rotated in its own plane at high speeds, and concentric with this disc a solenoid surface in a helical groove of semi-circular section cut in the cylindrical surface of a massive marble ring. The ring is about 21 inches outside diameter, 15 inches inside diameter, and 7 inches in azial length.

The determination of the ohm involves the exact calculation of the co-efficient of mutual induction between this coil and the periphery of the disc, and therefore involves the exact measurement of the diameter of the coil and disc. This was done with a Whitworth measuring machine, a long series of observations in different directions giving a highly accurate result. To prevent any leakage of current from turn to turn, double silk-covered wire was used, brushed over with melted paraffin wax. The co-efficient of linear expansion of the marble was also determined. The phosphor-bronze disc was ground in place, so as to be made true on its axis of rotation, and its diameter and co-efficient of linear expansion were carefully measured.

Contact was made with the centre of the disc by a tube projecting into an axial hole in the disc and carrying a small stream of mercury. Three small tangential phosphor-bronze tubes were pressed lightly against the periphery of the disc at three points, separated by an angular distance of 120°. Mercury was passed through these tubes also, the effect being to greatly diminish the disturbances due to thermo-electric effects.

The method of determining the resistance was a zero method, the current in the field coil being passed through the resistance to be determined ; and the E.M.F. set up in the disc at the proper speed, being balanced against the fall of potential in this resistance. For balancing an extremely sesitive Ayrton-Mather galvanometer of the d'Arsonval type was used. Extreme care was taken in the preparation of the resistance coils, their comparison with the Board of Trade standard, and the determination of their temperature co-efficients. The thermometers used in tne investigation were carefully calibrated at Kew, and the clock which was used for the determination of the speed was compared with the time set from Greenwich.

The results of the successive measurements of the absolute resistances became very concordant after various possible causes of small errors had been gradually eliminated. Nine sets of observations taken on July 30, 1897, gave results for the value of the Board of Trade ohm in true ohms, which showed, when all corrections had been made, that one Board of Trade ohm = 1.00026 true ohms.

This result was then discussed in the light of all sources of error that could enter into it, and the effects that would be produced by such errors. The marble ring and the phosphor bronze disc were carefully tested in induction balances for the presence of possible traces of iron which would affect their permeability, no such effect being detectable with a sensitiveness to one part in 15,000. The final conclusion of the series of tests was that the Board of Trade ohm is between two and three parts in 10,000 larger than the true ohm. This is probably the most precise comparison of physical standards of resistance with their defined value ever made.

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	A.M. 2.40	A.M. 6.40	4.00
2....	" 3.30	" 6.40	3.10
3....	" 4.00	" 6.40	2.40
4....	No Light.	No Light.	.....
5....	No Light.	No Light.	.....
6....	No Light.	No Light.	.....
7....	No Light.	No Light.	.....
8....	P.M. 6.00	P.M. 9.40	3.40
9....	" 6.00	" 9.50	3.50
10....	" 6.00	" 11.00	5.00
11....	" 6.00	A.M. 12.10	6.10
12....	" 6.00	" 1.20	7.20
13....	" 6.00	" 2.30	8.30
14....	" 6.00	" 3.40	9.40
15....	" 6.00	" 4.50	10.50
16....	" 6.10	" 5.50	11.40
17....	" 6.10	" 5.50	11.40
18....	" 6.10	" 5.50	11.40
19....	" 6.10	" 5.50	11.40
20....	" 6.10	" 5.50	11.40
21....	" 6.10	" 5.50	11.40
22....	" 6.10	" 5 50	11.40
23....	" 8.10	" 5.50	9.40
24....	" 9.20	" 5.50	8.30
25....	" 10.20	" 5.50	7.30
26....	" 11.00	" 5.50	6.50
27....	" 11.20	" 5.50	6.30
28....	" 11.50	" 5.50	6.00
		Total......	191.30

SPARKS.

The London Electric Light Company have erected a small addition to their building.

Leonard & Son, of Dundas, Ont., have purchased an incandescent lighting plant from the Canadian General Electric Co.

The Danville Electric Light Co. have purchased a 60 kilowatt single phase alternator from the Canadian General Electric Co.

The Canadian General Electric Company are installing an isolated plant for R. F. Hicks, of Norwich, Ont.

The corporation of Magog, Que., have placed an order with the Canadian General Electric Company for a 2,000 light alternator of their single phase, revolving armature compound type.

The Richmond Light and Power Co., of Richmond, Que., are adding to their electric lighting equipment, and have placed with the Royal Electric Co., Montreal, an order for one of their 75 k.w. "S.K.C." generators and switchboard apparatus complete.

The Toronto Railway Co. have given an order to the Canadian General Electric Co. for an 850 kilowatt direct-connected generator. This machine will be a duplicate of that which has been in operation in their power house for two years past.

Messrs. Edgar & Roy, of North Hatley, Que., are at present enlarging their electric lighting plant, and propose to furnish power as well as light in the future. In order to be in a position to do this they have placed their order with the Royal Electric Co. for a 60 k.w. "S.K.C." two-phase generator, which will be installed immediately.

The Dechenes Electric Company are lighting the Russell House and Opera House in Ottawa. They have recently placed an order for several induction motors with the Canadian General Electric Company, to be operated from their monocyclic circuits.

The Edmonton Electric Light Co., of Edmonton, N.W.T., are improving and extending their plant. The new electrical equipment purchased by them from the Royal Electric Company consists of one 75 k.w. "S.K.C." two-phase generator, complete, with exciter and switch-board, as well as the necessary material for the other changes.

At the last meeting of the town council of Granby, Que., the question of a more complete and efficient electric light system was considered. It was moved that the secretary be authorized to advertise for tenders for an arc and incandescent plant, but at the suggestion of Mayor Miner the motion was allowed to stand pending definite information in regard to the tannery water power.

The new 100 arc light plant at Chatham, Ont., has been taken over from the contractors by the city, and is said to be running satisfactorily. The electrical apparatus, including dynamos, lamps and circuits, was furnished by the Thompson Electric Company, of Hamilton. In a later issue we hope to present an illustrated description of this plant, which is one of the largest yet to be installed in Canada under civic control.

The contract for the power transmission plant of the British Columbia Railways Company at Victoria, B.C., reference to which has already been made in this journal, has been awarded to the Canadian General Electric Company, and will consist of three-phase generators adapted for direct connection to Pelton water wheels, having an aggregate capacity of 1,500 horse power.

For the past two years a philanthropic association of Montreal, the St. Jean Baptiste Society, has organized a series of free lectures in their edifice, the Monument National. This year a series of lectures on "Practical Electricity" has been added to the programme, the lecturer being Mr. Louis A. Herdt, E.E., Consulting Engineer and Lecturer in Electrical Engineering at McGill University. These lectures were begun in October last, and are exceedingly well attended, over 200 people, young and old, in search of learning, having availed themselves of the opportunity thus afforded.

The Toronto branch of the Bell Telephone Company have issued to subscribers an improved telephone directory, which in point of convenience and general arrangement is especially worthy of mention. The book is well printed, and the absence of advertisements throughout the pages is a noticeable improvement. A complete list of the offices in Ontario and Quebec connected with the long distance lines appears in the front, while a numerical list of the telephones of the Toronto exchange, showing in the order of their numbers the page in telephone directory on which any number may be found, is also included.

The town of Parrsboro, N. S., is installing a complete arc and incandescent system, and has awarded contracts for apparatus as follows : Complete steam plant, including Monarch Economic boiler and two engines, Robb Engineering Co., Amherst, N. S.; arc dynamo and lamps, Thompson Electric Co., Hamilton ; alternating generator, Munderloh & Co., Montreal, as agents for the Warren induction type ; transformers, W. A. Johnson Electric Co., Toronto ; lamps and meters, Packard Electric Co., St. Catharines ; supplies, Canadian General Electric Co., Toronto. The plant is expected to be in operation by February 1st. Mr. Geo. White-Fraser, of Toronto, is consulting engineer.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make bis series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE IX.]

DIVIDED AND SHUNT CIRCUITS.

A conductor from one terminal of a generator may be divided into any number of divisions or branches. Each branch or division may vary in resistance, and they may all unite on reaching the other terminal.

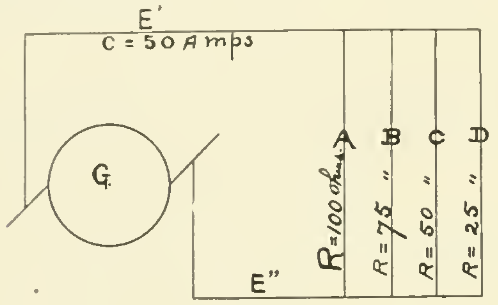


FIG. 2.

Example 6: A portion of the circuit connected with generator G in Fig. 2 consists of 4 parallel conductors, A, B, C and D. R of A = 100 ohms; B = 75 ohms; C = 50 ohms, and D = 25 ohms, what will be the ratio of current passing through the circuit which will pass through each conductor.

According to Rule 1 the current passing through each of the conductors A, B, C and D will be inversely proportionate to its resistance.

$$\therefore \text{As } A : B : C : D :: \tfrac{1}{100} : \tfrac{1}{75} : \tfrac{1}{50} : \tfrac{1}{25}$$

Or to simplify:

As A : D 100 : 25
B : D :: 75 : 25
C : D :: 50 : 25

That is, that the ratio which current passing through conductor A bears to current passing through conductor D is the same as the ratio that the resistance of conductor A bears to R of conductor D, and so on for all the other conductors.

Example 7: Supposing the current passing through terminals of generator, and consequently through circuit, to be 50 amperes, what amount of current will pass through each of the branches, A, B, C and D, in foregoing problem.

To determine the amount of current that will pass through parallel circuits of different resistances, take the resistance of each branch in ohms as a denominator, having 1 as a numerator. Reduce the fractions to a common denominator and add together the new numerators. Take the sum of the numerators as a new common denominator, and the single numerators as new numerators, and new fractions will express proportional currents passing through portions of circuit as units of one.

$$\text{Then } \tfrac{1}{100}\ \tfrac{1}{75}\ \tfrac{1}{50}\ \tfrac{1}{25}\ \frac{3 \cdot 4 \cdot 6.\ 12}{300}$$

And sum of numerators equals 25, using this as per rule $\frac{3 \cdot 4 \cdot 6 \cdot 12}{25}$

∴ current passing through branches expressed in units of one must equal: $A = \frac{3}{25}$; $B = \frac{4}{25}$; $C = \frac{6}{25}$; $D = \frac{12}{25}$.

Total current passing through circuit is given as 50 amperes.

Then current passing through $A = \frac{3}{25} \times 50 = 6$ amp.
" " " " $B = \frac{4}{25} \times 50 = 8$ amp.
" " " " $C = \frac{6}{25} \times 50 = 12$ amp.
" " " " $D = \frac{12}{25} \times 50 = 24$ amp.

It will be observed in Fig. 2 that current passing through circuit first passes through conductor E^1, and when parallel branches are reached four paths are provided for its passage, when it again unites on conductor E^{11}.

It is quite evident that the more paths there are provided for the passage of the current the less resistance will be offered. This brings up a problem as to resistance offered by the parallel branches of a circuit as compared with a single conductor.

It is quite clear that we cannot summarize or add the resistances of each parallel branch together. If branch A had only been provided, then resistance of A would have been the resistance of that portion of the line, but addition of other branches clearly reduces resistance of each branch to flow of current by providing another path for its passage.

In divided circuits the resistance of the combined branches is expressed by the reciprocal of the sum of the reciprocals of the resistances.

Example 8: Find the resistance of the combined branches, A, B, C and D, as set forth in foregoing examples.

The reciprocal of resistance is conductance expressed usually as Mhos, a derivate of the word Ohms.

The reciprocal or conductance of the four branches then is:

$$\tfrac{1}{100} + \tfrac{1}{75} + \tfrac{1}{50} + \tfrac{1}{25} = \tfrac{25}{300} \text{ or } \tfrac{5}{60} \text{ Mhos.}$$

The resistance of the combined branches is as 5 : 60 = 12 ohms.

Application of Rule 3 to this problem proves that the E M F on each of branches is equal 600 volts.

R of A = 100 ohms and C = 6 amps. E M F 600 volts.
R of B = 75 " " = 8 " " " 600 "
R of C = 50 " " = 12 " " " 600 "
R of D = 25 " " = 24 " " " 600 "

And combined resistance of A, B, C, D = 12 ohms combined. C = 50 amps. E M F 600 volts.

Perhaps a clearer method of arriving at the combined resistance of parallel circuits is to use the formula

$$R = \frac{R \times R^1}{R + R^1}$$

Which is based on the principle that the combined resistance of two parallel circuits can be found by multiplying their resistances together and dividing the product by the sum of their resistance.

By this method, combining A and B we get $\frac{100 \times 75}{100 + 75} = 42.8$ ohms.

Combining C and D we get $\frac{50 \times 25}{50 + 25} = 16.7$ ohms.

Then combining these two products we get $\frac{42.8 \times 16.7}{42.8 + 16.7} = 12$ ohms combined R of branches A, B, C and D.

If the whole of the branch circuits were of uniform resistance, then formula could be very much simplified by using formula

$$R = \frac{R}{N}$$

When the resistance of one branch is divided by the number of branches the quotient will be the combined resistance of all the branches.

Example 9: What would be the combined resistance of four parallel branches each having a resistance of 100 ohms?

$$\tfrac{100}{4} = 25 \text{ ohms.}$$

STRENGTH OF STAYS AND FLAT SURFACES.

We require here to find area and number of stays required, area of surface supported by one stay, and the pressure that may be allowed against any flat surface.

The greatest stress per square inch of section of an iron stay allowed is 6000 lbs. Then calling this the T. S. (tensile strength) of our formula, the total stress on a stay may be found by the following formula:

$$\text{Stress (S)} = a \times T\,S$$

Example: Find the stress allowable on a direct stay $1\frac{1}{4}$ inches in diameter when the stress allowable equals 6000 pounds per square inch section.

$S = a \times T\,S = 1.25^2 \times .7854 = 1.2271$ square inches of section.

$1.2271 \times 6000 = 7362.6$ total stress allowable on stay.

Example, the stays of a boiler are $1\frac{1}{4}''$ in diameter and placed 12 inches apart, what should be the working pressure of the boiler if the stress allowable per square inch section of stay is 6000 pounds.

Rule: First find the stress the stay is capable of supporting, then divide the result by the area held up by each stay and the quotient with the pressure allowable on the boiler.

$1.25^2 \times .7854 = 1.2271$ square inches section of stay.

$1.2271 \times 6000 = 7362.6$ total stress allowable on stay.

Since the stays are 12 inches apart or 12 inches from centre to centre of stay, each stay must support a section of plate equal to 12 inches squared.

Then $12 \times 12 = 144$ square inches area, supported by each stay. Then $7362 \div 144 = 51.1$ pounds pressure allowable on the boiler.

Rule to find required diameter of stay: Area of section in square inches held up by each stay multiplied by pressure on boiler divided by stress allowable per sectional inch on stay equals required area of stay.

$$\sqrt[2]{\text{area} \div .7854} = \text{diameter.}$$

Example: Find the required diameter of a direct stay when allowable stress on stay is 6000 pounds per square inch of section and stays are 15 inches apart with boiler pressure at 75 pounds per square inch.

$15 \times 15 = 225$ square inches of surface supported by stay.

$225 \times 75 = 16{,}875$ pounds stress on each stay.

$16{,}875 \div 6000 = 2.81$ square inches required area of stay.

$\sqrt[2]{2.81 \div .7854} = 1.9$ diameter of stay required.

Example: the stays of a boiler are $1\frac{1}{2}$ inches in diameter and capable of sustaining a stress of 8,835 pounds, what distance must they be pitched apart to sustain a working pressure of 60 pounds to the square inch?

Rule: $\frac{8835}{60}$ = area of section, and square root of area of section equals pitch or distance from centre to centre of stays.

$8835 \div 60 = 147.2$ area of section to be supported in square inches. $\sqrt[2]{147} = 12.125$ length of each side of section of plate, or required pitch of stay $= 12\frac{1}{8}$ inches.

Proof: $12.125^2 \times 60 = 8{,}820$.

[Note.—This result would have been exact had fractional parts of an inch been worked out.]

We now have rules for three of the most important determinations relating to stays:

1st. Determining the total weight or stress that a stay is capable of supporting.

2nd. Determining the required diameter of a stay when total weight to be sustained is known.

3rd. Determining the area of surface a stay of given dimensions is capable of supporting under known conditions.

To practical operating engineers these questions are of great importance; I will therefore repeat the examples under conditions which they may be expected to be met with in ordinary practice.

Example: The stays on a flat surface are 12 inches apart centre to centre, and through corrosion, have eaten away to 1 inch in diameter. The pressure per square inch on the boiler is 60 pounds, what is the strain per square inch section of stay, and to what pressure should the strain be reduced to give a stress of 5,000 pounds per square inch section of stay.

$12 \times 12 = 144$ square inches held up by each stay.

$144 \times 60 = 8640.$ pounds held up by each stay.

$1^2 \times .7854 = .7854$ square inches sectional area of stay.

Then stress per square inch section of stay equals:

$$8640 \div .7854 = 11.000$$

This is clearly sufficient to break the stay and render the boiler unsafe.

$5000 \times .7854 = 3927$ pounds weight that stay is capable of sustaining.

$3927 \div 144 = 27.27$ pounds safe working pressure.

And therefore to comply with conditions named that strain on stay must not exceed 5000 pounds per square inch of section, boiler pressure must not be allowed to exceed 27.27 pounds per square inch.

Example: The stays of a boiler are 10 inches apart, and one of them breaks, throwing more stress on the four surrounding stays. The stays are $1\frac{1}{8}$ inch in diameter, and the boiler pressure is 50 pounds per square inch, what extra stress will be placed per square inch of section of stays if area supported by each has been increased by $\frac{1}{3}$, and what must the boiler pressure be reduced to so that stress per square inch section of stay shall not exceed original stress.

Stress held by each stay equals

$$10 \times 10 = 100 \times 50 = 5000 \text{ pounds.}$$

Sectional area of stay equals—

$1.125 \times 1.125 \times .7854 = .994$ square inches, stress per square inch of section before the break $= 5000 \div .994 = 5030$ pounds.

Then stress per square inch of section after the break =

$5030 + \frac{1}{3}$ of 5030, or $5030 + 1676.66 = 6706.66$ pounds.

Stays before break supported $10 \times 10 = 100$ square inches of surface, and after the break they are called upon to support $\frac{1}{3}$ more, or 133.33 square inches.

Original stress per square inch section of stay $= 5030 \div 133.33 = 37.7$ pounds per square inch, to which point pressure must be reduced so that original stress on stays may be maintained.

Example: What is the total pressure on the flat bottom of a boiler 18 feet 6 inches long by 6 feet wide, the pressure of the steam being 30 pounds per square inch, and the depth of water 10 feet 5 inches. Find also the required number of stays $1\frac{1}{2}$ inches in diameter, and what diameter they must be pitched apart when the stress per square inch of section of stay shall not exceed 6000 pounds.

Take a column of water 1 foot high and 1 square inch in area as weighing .434 pounds.

10 feet 5 inches equals 10.416 feet.

$\therefore 10.416 \times .434 = 4.51$ pounds pressure per square inch through weight of water.

Then $4.51 + 30 = 34.51$ total pressure per square inch on bottom of boiler. The boiler is $18'\,6''$ by $6' = 18.5 \times 6 = 113$ sq. feet area.

$113 \times 144 = 16272$ area of boiler in square inches.

$16272 \times 34.51 = 561{,}546.72$ pounds total weight bottom of boiler is called upon to support.

Area of stay equals $1.5^2 \times .7854 = 1.767$ square inches.

$1.767 \times 6000 = 10602$ pounds weight that one stay is capable of holding up.

$561{,}546.72 \div 10602 = 53$ nearly number of stays required.

Or we might say since each stay is capable of supporting 10602 pounds, $10602 \div 34.51 = 307$ square inches area of plate each stay can support.

16272 total area of boiler $\div 307 = 53$ number of stays required.

$\sqrt{307} = 17.5214$ inches distance from centre to centre of stay.

The Acetylene Lighting Company has been formed at London, Ont., to manufacture apparatus for the production of acetylene gas.

The Canadian General Electric Company are supplying a 1,000 light direct-connected, incandescent lighting plant to the Gutta Percha & Rubber Mfg. Co. This installation will be, when finished, one of the most complete in the country. The machine is of the steel frame, ventilated armature type, direct-connected to an "Ideal" engine, running at the slow speed of 280 revolutions per minute. The great saving in space, durability and high efficiency, obtained by the use of these direct-connected units, has led to their almost exclusive adoption as the standard machine where it is desired to obtain the best and most economical conditions in operating an isolated incandescent lighting plant.

The Colonial Lighting Syndicate is said to be endeavoring to secure control of electric light, gas and street railway systems in Ontario. A recent issue of the Belleville intelligencer says: The proprietor of this paper has been in regular communication for many months with a Toronto firm acting in the syndicate's interests, and we are given to understand that if the negotiations go through, it is the intention of the syndicate to extend the road to Tweed, using heavy rails that will enable the C. P. R. to haul their cars to and from that village, a contract for that purpose to be entered into with the railway company. We also understand that Sir William Van Horne has agreed to give a certain sum of money towards the enterprise. The street railway is also to be run to Trenton. The object of the syndicate is to secure a number of similar enterprises in Canada, operating these under one system, which it is now doing in Ceylon, where the representative now in Canada has been for twelve years.

ELECTRIC RAILWAY DEPARTMENT.

THE WEST INDIA ELECTRIC COMPANY.

Reference has been made in previous issues of this journal to the formation of a company, composed chiefly of Canadian capitalists, to build an electric railway at Kingston, Jamaica. The directors of the company, which will be known as the West India Electric Company, Limited, are : F. S. Pearson, of New York ; Hon. Senator L. J. Forget, W. B. Chapman, William McLennan and C. E. L. Porteous, of Montreal, and E. A. Haggart, of Jamaica, the latter representing the Board in the island. Some of these gentlemen have just returned from Jamaica to Montreal, and report the undertaking as progressing favorably. The old street car system has been taken over and contracts awarded for the building of the new road, which will be about twenty-five miles in length, with possible extensions, and will cost in the vicinity of half a million dollars. It is also probable that electric lighting will be taken up.

Recently the new directors reduced the fares one-half, and the first day's earnings are said to have shown an increase of 30 per cent.

The company are fortunate in having secured as their manager Mr. Henry Holgate, in whom for nearly three years has been vested the management of the Montreal Park and Island Railway. Mr. Holgate was born at Milton, Ont., in the year 1863. After serving his apprenticeship in railway work, he became chief engineer of the combined Northern and Great Northern Railways, which were merged into the Grand Trunk in February, 1888. Four years later he resigned to accept a position as engineer with the Central Bridge and Engineering Company, of Peterboro', and in June, 1894, removed to Montreal and became engineer for the Royal Electric Company, superintending the building of their new factory. At that time the directors of the Royal Electric Company were interested in the Montreal Park and Island Railway, and Mr. Holgate was transferred to the management of this road in June, 1895, in which capacity he has since continued.

Mr. Henry Holgate, C.E.
Manager West India Electric Company.

Mr. Holgate's extended railway and general engineering experience should prove of great benefit to him in his new field. We are pleased to present his portrait herewith.

LEGAL.

London Street Railway Co. vs. City of London.—The Board of Judges rendered their decision last month in the appeal case of the London Street Railway Company against an assessment on rails, poles, wires and cars, the judgment upholding the assessment. In order to simplify matters, the appeal was argued in two sections : 1st, against the assessment of $80,000 on rails, poles and wires as real estate ; and 2nd, against the assessment of $50,000 on the cars as personal chattels of the company. Judge Hughes and Judge Elliott entirely agreed in upholding the Court of Revision in both instances, Judge Finkle holding the cars to be non-assessable. Judge Hughes, in his judgment, pointed out that the statutes under which the company operated curtailed the common-law right of the public to the use of the road by giving an exclusive occupancy for the time being of their cars, rails, poles, wires, etc. He therefore held that it was the public and not the company which enjoyed merely an easement of the street, and quoted Chancellor Rose's decision in the case of the Consumers' Gas Co. vs. Toronto, in support of this contention. This decision of the Supreme Court, he thought, exhausted everything that could well be said on the subject, and settled the law in the main features of the present case. His judgment in part was as follows : "I therefore think the appellants, as respects this subject of appeal, must be dismissed, and the decision of the Court of Revision in respect thereof upheld and affirmed, with costs to be paid by the appellants of the company. As to the cost of construction, I must believe that there was no real intention of placing a separate or enhanced tax upon the costs ; of placing the other subject of assessment, i.e., realty, beyond what they are worth if so placed, for I cannot understand that if in the valuation of this property the assessment commissioner or the Court of Revision ever intended to place a tax upon property beyond the intrinsic value when assessed. How, for instance, can a bridge be assessed at the value of the cost of its construction supposing the contractor who built it received a great deal more or a great deal less than it is worth, or because he so slighted his work that it is not nearly so safe or efficient for the purposes that it was intended or contracted for? In respect to the assessment of the cars of the appellants' company, I regard them as movable chattels, which are not attached to the freehold or the wires, poles, or machinery of the railway, much less the rails upon which they are propelled. The propelling power, electricity, by no means fastens them to the freehold. . . . And therefore, in the absence of proof which would bring the chattels of the railway company within some one of the exceptions provided by the Assessment Act, that they are otherwise assessable, I would uphold and affirm the Court of Revision in respect thereof, and dismiss the appeal on all parts with costs to be paid by the company." In his judgment, Judge Elliott recited at length the contentions, and asked if there was any substantial difference between gas pipes and rails on the street with regard to the occupancy of the soil. The decision of the Supreme Court in the case of the Consumers' Company vs. Toronto held that there was not. The judge went on to quote extensively to show that there was no reasonable distinction between the two cases, and wound up the first part with the brief line : "I therefore conclude that the objection is not tenable." Regarding the second point, the judge held that the cars differed from the rails, poles and wires, which if separated from the main building would render the whole inoperative, and he went on to say, and therefore thought the cars assessable as personalty at $50,000. Judge Finkle also held that the case of the Consumers' Gas Company was not distinguishable from the case in point, and gave judgment accordingly. "As to the cars," said he, "I am unable to satisfy myself that the cars are realty. . . . I feel that the ars care not a class of property liable to assessment, and decline to ratify the assessment of the Court of Revision, and direct that the assessment as to street cars shall be stricken out, and that the costs in this particular class shall be paid by the city of London."

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TORONTO - ONTARIO

SPARKS.

John Campbell, of St. Thomas, Ont., is installing a 100-light dynamo in his mill.

The telephone cable between Quebec and Levis was carried away by the ice recently.

The Canadian Gnneral Electric Company have installed an isolated plant for Messrs. A. & J. Clarke, Bullocks Corners, Ont.

The village of Huntingdon, Que., has purchased the electric light plant from the Stadacona Water, Light & Power Company.

Manager Leather, of the Hamilton Radial Electric Railway, says the line will be extended to Bronte by May 1. The road has been built into Burlington.

The British Columbia Iron Works Company, of Vancouver, have placed an order for a 10-kilowatt, direct connected, steel frame, incandescent lighting generator with the Canadian General Electric Company.

The Shipton Electric Co., of Danville, Que., have decided to proceed with the extension of their power plant this winter, and have made a contract with the Jenckes Machine Co., of Sherbrooke, for one of their Crocker turbines, horizontally set, with penstock and draft tube complete.

The proposition to build an electric railway from Amherstburg to Windsor came up at a recent meeting of the Amherstburg Council. It was stated that a Mr. Jacobson was willing to build the road on the same terms as the Windsor, Amherstburg & Lake Erie Railway, whose by-law was defeated.

The Dominion Wire Company, of Montreal, have elected officers as follows: James Cooper, president; C. W. Vollmann, vice-president; J. C. McCormick, managing director; F. W. Fairman, assistant managing director; H. Horsfall, works superintendent; Albert Hannah, secretary-treasurer.

Mr. Frank Jaynes, general superintendent of the Western Union Telegraph Company, states that his company are preparing to extend their line to Victoria and Vancouver, B.C. The route likely to be adopted is the one followed by the C. P. R. cable, a land line being built from Anacortes to the Terminal City.

The electric lighting system was recently inaugurated at Magog, Que., and is said to be very satisfactory. For private lighting the following rates are charged for 16 c.p. lights: Private dwellings—3 lights, $3.25 per annum each; 4 to 5, $3 each; 6 to 9, $2.50 each; 10 to 19, $2.25 each; 20 and over, $2 each. Stores—3 lights, $4 per annum each; 4 to 5, $3.25 each; 6 to 9, $3 each; 10 to 19, $2.50 each; 20 and over, $2.20 each.

David Russell, of Montreal, John Joyce, of Boston, William Straham, and others, will apply to the Quebec Legislature for incorporation as the Shawenegan Water & Power Company, with power to acquire and develop water powers on the Saint Maurice and Shawenegan rivers; for general powers for the development of power, generation of electricity, the sale and leasing of the same, and the manufacture of calcium carbide, acetylene gas, electric light and other products.

At the Toronto Technical School 171 pupils have succeeded in taking certificates during the past year, and four have been awarded diplomas. Those winning diplomas are as follows: J. Chalkley, trigonometry, applied mechanics, perspective, graphic statics, descriptive geometry, and building construction; Walter Inglehart, applied mechanics, steam engine, electricity, machine drawing, and machine construction; E. W. Adams, trigonometry, applied mechanics, steam engine, sound, light, graphic statics, and euclid; R. H. Chalkley, trigonometry, applied mechanics, algebra, euclid, perspective, graphic statics, descriptive geometry, and building construction.

The Standard Light and Power Co. has absorbed the Temple Electric Co., situated on Chenneville street, Montreal, which supplies electricity to a large number of business firms. The deal was practically arranged a month ago, but the directors of the Temple Company only recently met and gave a formal consent to the sale, which makes the Standard Company one of the most important electrical concerns in Canada. The Lachine Rapids Hydraulic & Land Company will in future furnish the power to the Standard Company under a contract just made, and which means the turning over of many thousands of dollars. The Lachine Company has also brought to a successful consummation its efforts to supply power to the Imperial Electric Co. for five years.

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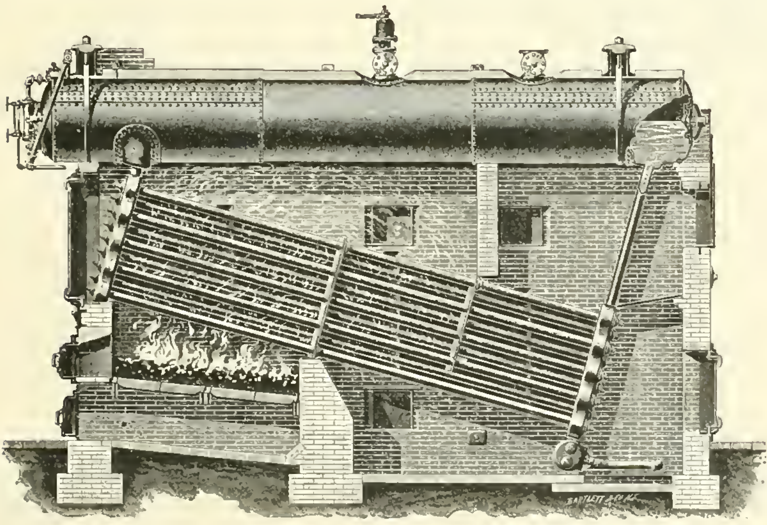
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SPARKS.

Taylor, Telfer & Co. are successors to the electrical supply business of C. W. Henderson, Bleury street, Montreal.

The Royal Electric Company have taken over the electric light plant at Aurora, Ont., from the Metropolitan Lighting Company.

The Canadian General Electric Company are installing a 100-light incandescent plant for the Tillson Company, Limited, of Tilsonburg, Ont.

The St. Lawrence Sugar Refinery Company, of Montreal, have placed an order for two 45-kilowatt incandescent lighting dynamos with the Canadian General Electric Company.

The car barn of the Port Arthur Electric Street Railway, including rolling stock, was burned to the ground on December 15th. The railway and plant is owned by the town.

The street car system at Moncton, N.B., has not been a financial success, and the directors of the company have decided to discontinue the service during the winter months.

The Edwardsburg Starch Co., of Cardinal, Ont., are installing a 1,000-light incandescent plant. The Canadian General Electric Company have the contract for the complete installation.

Mr. J. B. McWilliams, of Peterboro', Ont., is said to have interested English capitalists in the water power of the Otonabee river, and as a result a company may be formed to develop the power.

The British Columbia Electric Railway Company is now experimenting with two kinds of fenders on their cars in Victoria, and the one found most satisfactory will be adopted for the cars of the entire system.

The Auburn Power Company, of Peterboro', Ont., have placed an order with the Wm. Hamilton Mfg. Co., of that town, for two new water wheels. These wheels will enable the company to double their electrical output.

It is proposed to hold a "Pan-American" exhibition in 1899. The site proposed is Cayuga Island, containing about 175 acres on the Niagara river, a few miles above the Falls. In view of the vast amount of power in the vicinity, it has been suggested to the promoters that electricity should predominate in the exhibition, including the restaurants, where the products of electrical cooking will be obtainable in a variety of forms.

C. E. SHEDRICK
Manufacturer of — SHERBROOKE, QUE.
HIGH GRADE ELECTRICAL APPARATUS
Licensee of the Whitney Electrical Instrument Company's Patents in Canada.
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TRADE NOTES.

The Canadian General Electric Company are supplying a 350-light incandescent plant for the new Booth elevator at Parry Sound.

The Windsor Plaster Co., Windsor, N. S., are lighting their works by electricity, and have given the order for the electrical equipment to the Royal Electric Co.

The Kent Mills Company, of Chatham, Ont., have purchased an incandescent lighting generator from the Canadian General Electric Company.

The Dominion Paper Mills, of Kingsey Falls, Que., are installing an electric lighting plant in their new mills, and have placed the contract with the Royal Electric Co.

The Thompson Electric Co., of Hamilton, have recently sold a 35-light arc plant, complete, to the corporation of Parrsboro, Nova Scotia, and a plant of same capacity to the Port Dover Electric Light Co.

The Virginia Mines at Rossland have passed the preliminary stage, and will now enter the list of shippers. An order for a large hoisting plant, with boilers, has been placed with the Rossland branch of the Jenckes Machine Co., of Sherbrooke, and is now on the way from the east.

Attention is called to the announcement in the advertisement pages of this number that the name of the Kay Electric Manufacturing Co., of Hamilton, has been changed to the Hamilton Electric Manufacturing Co. The business of the company will be continued under the new name at the same address as before.

The Weeks-Eldred Co., of Toronto, have removed from the Board of Trade to No. 80 Canada Life Building, where they have very convenient offices. This company recently placed one of their Jones underfeed mechanical stokers in the Windsor Hotel, Montreal, and the value thereof may be estimated from the fact that it is said to have effected a saving of $150 per week.

The W. A. Johnson Electric Company recently sold a 100-light arc dynamo to the Citizens Telephone and Electric Company, of Rat Portage, Ont. This is claimed to be the largest arc machine yet manufactured for sale in Canada. A letter from the company states that the dynamo is very satisfactory, a noticeable feature being the absence of undue sparking at the brushes.

The Canadian General Electric Company have recently closed a contract with the Bushnell Oil Company, of Sarnia, for a 25-kilowatt, direct connected, steel frame, incandescent lighting generator, coupled to an Ideal engine. This installation will embody all the latest improvements in direct connected practice, which the Bushnell Company, from their connection with the Standard Oil Company of the United States, have learned to value through their experience there.

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ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. VIII. FEBRUARY, 1898 NO. 2.

MR. E. H. KEATING.

MR. E. H. Keating, who for the past six years has been city engineer of Toronto, resigned that position on January 31st last to assume the management of the Toronto street railway. Mr. F. L. Wanklyn, who had been acting as manager of both the Toronto and Montreal railways, found that his duties in Montreal would require his undivided attention, and hence the need of a resident manager in Toronto.

While Mr. Keating's resignation as city engineer was the subject of general regret by Toronto citizens, there were also heard many expressions of pleasure that his connection with the city was not to be entirely severed; on the contrary, in his new field the citizens may rely upon every consistent effort being put forth to afford both quick and comfortable transportation. The company alike must certainly feel that in Mr. Keating they have an officer possessed of executive ability of the highest order.

The subject of this sketch has had a varied civil engineering experience. He was born in Halifax, N. S., in the year 1844, and completed his education at Dalhousie College. After graduating, he served for some time under George Wyhtman, the Government engineer. He took part in the survey of the Pictou Railway in 1867, under that famous engineer, Mr. Sandford Fleming. A little later he was appointed assistant engineer of the Intercolonial, and for a short time was draughtsman on the Windsor and Annapolis railway, returning to the Intercolonial during the construction period.

MR. E. H. KEATING,
Manager Toronto Street Railway Company.

In 1870, when the work of surveying was entered into on the highlands between Hudson Bay and Lake Superior, for the Canadian Pacific Railway, Mr. Keating again engaged under Mr. Sandford Fleming, and did good service in this particular work. In the same year he accepted the position of City Engineer of Halifax. This position he held from 1871 to 1890, having charge of the construction of many important civic works, particularly the waterworks and the Halifax graving dock. During this time he also practised as consulting engineer, and evidence of his skill and ability in engineering directions is scattered throughout the province of Nova Scotia. In 1890 he was offered and accepted the position of City Engineer of Duluth, remaining there until July, 1892, when he became City Engineer of Toronto. In this capacity he carried out some of the most important contracts ever undertaken by the city, and acquitted himself in such a manner as to prove beyond a doubt his exceptional ability. While the street railway system was being changed to electric traction, his services were frequently called into requisition in the interest of the city. In this way he became quite familiar with the working of the system, and obtained an experience which should serve him to advantage in his present position.

PROGRESS OF THE KOOTENAY POWER PLANT.

THE work of developing the water power available at the Falls of the Kootenay river, in British Columbia, which has been undertaken by the West Kootenay Power and Light Company, is nearing completion. The machinery is now being installed, and early in March the company hope to be supplying electric power for the various mining operations within a radius of fifty miles of Rossland.

As already stated in this journal, the promoters of the enterprise are Sir Charles Ross, the Scotch baronet, Messrs. C. R. Hosmer, Frank Paul, Wm. Doull, and other well-known capitalists. In a recent interview Sir Charles Ross gave some interesting particulars of the undertaking and proposed operations of the company.

The power house of the company is situated at Bennington Falls, about 10 miles below Nelson, on the Kootenay river. Water is conducted to the reservoir from the Kootenay river by a canal-way 30 feet deep and 27 feet wide, cut out of the solid rock for a distance of 640 feet. The dam, which is of concrete, is 32 feet high and 18 feet thick at the base. It extends for the full distance across the fore-bay, some 54 feet, and is reinforced on the sides by huge abutments of concrete. The average rise of the Kootenay river is 22 feet, and the highest flood on record was 32 feet above the minimum height of the stream. The dam, therefore, is calculated to withstand the severest floods which it is likely to encounter. From the fore-bay the water is carried to the turbine wheels by three steel pipes, two of which are nine feet in diameter, while the third is a foot larger. At present only the two former tubes will be used. The wheels will develop 1,450 horse power each, so that their united force is 2,900 horse power. Each wheel weighs 40,000 pounds.

The turbine wheels are attached direct to the generators, without the use of gearing. The gates for regulating the supply of water are electrically governed. The electrical apparatus, which was furnished by the Canadian General Electric Company, is of the three-phase alternating type, similar to that installed at Montreal for the Lachine Rapids Hydraulic & Land Company. There are two generators, having together a capacity of 2,500 h.p., giving a voltage of 1,040 when revolving at 180 rev. per minute. The exciters used in connection with the generators are operated by two special turbine wheels of their own. The generators are connected by heavy cables to a marble switchboard, from which the current is connected to the step-up transformers, which increase the pressure from 1,040 to 20,000 volts. The electrical current is conducted to the sub-station at Rossland over a three-wire line 30½ miles long. The local sub-section, which is situated on the Monte Cristo ground, is equipped with a high potential switchboard, a distributing switchboard and a series of transformers, which reduce the pressure from 20,000 to 2,080 volts. From the sub-station power will be conducted to the various mines, and where necessary, still further reduced for transmission to the motors.

The president of the company is Mr. Oliver Durant. Mr. Robert Jamieson, formerly engineer for the Lilooet, Fraser River & Caribou Gold Fields Co., is general manager and chief engineer, and Mr. L. A. Campbell installing expert for the Canadian General Electric Company.

MICA PRODUCTION IN CANADA.

THE immense quantities of mica found in Canada, and its increasing use for electrical and other purposes, is attracting capitalists to the mica properties of this country. The United States and Great Britain use our mica quite extensively, and with the growth of the electrical business the demand promises to become much greater. As early as 1863 Sir William Logan referred to the deposits of "muscovite," or "white mica," then known to exist on Yeo's Island, Cape Tourmente, and other sections of the province of Quebec. Mention is made in his Geology of Canada of the phlogophites or "amber" mica at Grenville, Quebec, and in North and South Burgess, Ontario, in all of which the mica is obtained in large sheets, which, being transparent and free from flaws, are wrought and employed for the same purpose as the "muscovite" or potash varieties. An early producer was the Sydenham property, in the Kingston district, and the important deposit of "muscovite," particularly referred to by Dr. A. R. C. Selwyn, C.M.G., F.R.S., director of the Geological Survey of Canada, in the report of the Royal Commission on the Mineral Resources of Ontario, has been opened up at Villeneuve, in Ottawa County, while at Templeton, about 16 miles from the city of Ottawa, several extensive deposits of first-class amber mica, notably on the Wallingford property, have been worked. Dr. Selwyn's opinion of the Villeneuve "muscovite" mica is fully confirmed by another well-known Canadian expert, Prof. F. Cirkel, who has also reported in high terms on the Wallingford and Lake Girard properties.

Mica is a crystalline mineral, which, in association with several other minerals—as pyroxene and felspar—forms the rocks we know as gneiss and granite, and is capable of being cleaved into elastic plates of extreme thinness. Both its color and commercial value are greatly influenced by the mineralogical peculiarities of the rock in which it occurs or has been associated, and also by the manner in which it has been deposited after the decomposition of the rock in which it originally occurred.

In Great Britain the incandescent gaslight companies are largely using it for chimneys, instead of glass. The insulating power of mica is superior to that of any other substances applicable to armatures and commutators. An advantage peculiar to itself is its even laminated structure. The builders of armatures can split sheets into any desired and uniform thickness with great ease and accuracy. A valuable property of mica in connection with commutator insulation is its degree of hardness; it does not wear away too rapidly under the action of the brushes. Of all substances, mica is probably the best material for insulation in certain parts of armatures if it is desired to obtain not only efficient electric insulation but also durability under the influence of heat. The highest temperature to which an armature is subjected, even by short circuits or bad constructions, will have no injurious effect on mica, thick or thin. It may be held in a gas flame without burning or melting. It has been proved that a sheet of 4 in. in thickness will stand the strain of a voltage of close upon 5,000 volts. Mica being infusible, tough, non-combustible, and, when split in sheets, transparent, has a multiplicity of industrial uses.

The mineral is somewhat extensively used in the manufacture of mica grease. As a lubricant for railroad purposes, bicycles, etc., its value lies in its absolute anti-friction, and it is claimed that with its use hot boxes or journals are impossible. A profitable employment of the immense quantities of scraps and fragments of waste mica is the substitution of mica for glass in spectacles worn by workmen (such as electric welders and stone and metal workers) to protect their eyes from sparks, chips or splinters. These mica glasses are concave, in the shape of watch glasses, and are about 1-25th of an inch in thickness. The advantages gained by this utilization are greater than would at first be imagined. Mica spectacles have the advantage over glass that they cannot be broken. Pounding with a sledge hammer merely flattens them, nor does a splash of molten metal coming in contact affect the mica eye-shade.

One of the most recent uses to which mica is commercially applied is in the manufacture of "micanite," by which large quantities of scrap or inferior qualities are utilized, and, by means of a patented process, small pieces of waste mica are built up into sheets 40 in. square, and larger if necessary. This product can be made in any desired form, and is also largely supplied to the electrical trade for insulating purposes. As a covering for boilers mica possesses various advantages over any other material. Many other ways of utilizing mica might be given, but enough has been said to show that there is an ample market for a material with which the electrical industry is already very familiar.

WELL PLEASED.

MR. William T. Frizzell, Chief Engineer Consumers Cordage Co., Dartmouth, Nova Scotia, in renewing his subscription to the ELECTRICAL NEWS, writes: "Please send me January's copy, as I do not wish to miss a number. I am well pleased with the paper. I think it is growing more interesting."

BY THE WAY.

THE woman has now invaded the electrical field. Word comes from Syracuse, N. Y., that a new opera house there has just been wired by Mrs. W. J. Blackburn, wife of a theatrical electrician. She had full charge of the work, which was quite complicated, and included 1,250 incandescent lights for the auditorium, stage and lobby. Mrs. Blackburn is said to make a specialty of designing switchboards, and has assisted her husband in many important contracts. She is believed to be the only woman in America engaged in this class of work.

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IN a certain Canadian city a widow and her two sons kept store on a leading thoroughfare. We will call their name Jones. The sons' initials are respectively R. J. and J. W. The former after a time decided to leave the paternal roof, and commenced business on his own account on the same street. This was the starting point of keen business rivalry. R. J. Jones transposed his initials in order to have his name appear first on the Telephone Company's list of subscribers. Before the next issue of the book, his brother had caught on to the scheme, and notified the manager of the Telephone Exchange that the name was not correctly printed, and that it should appear in its proper alphabetical order further down the list. Soon after the new directory list containing this correction was published, R. J. called the telephone manager's attention to the fact that the business with which his brother was connected belonged to his mother, and that consequently the name in the directory should be "Mrs. J. W. Jones." R. J.'s star is thus once more in the ascendant, and the telephone manager is quietly waiting to see what is to be the next move on the board.

THE KINGSLEY WATER TUBE STEAM BOILER.

THIS boiler, which has been installed in a large number of steam plants in Canada during the last year, stands with the highest records and recommendations from its users.

Perhaps its merits cannot be better summarized than by quoting from the report of this boiler made by the American Institute of New York : "We submit herewith a report of test made by us, assisted by Messrs. Jacobus and Treber, of Stevens Institute of Technology, and while making the same, discovered the following points, which are worthy of special commendation, viz.: The large amount of power developed in the small space occupied ; rapid steam formation in the small space occupied ; rapid steam formation without any foaming ; very dry steam from water of evaporation. The construction of the boiler is such that it can be built to withstand any pressure desirable, and all parts are readily accessible for cleaning and repairs when necessary. The tubes are very readily removed and new ones replaced."

The Franklin Institute of Philadelphia reported after their tests that the Kingsley boiler does one-third more work per pound of coal than does the return tubular boiler.

The tubes are perfectly free from sediment at all times, as can be verified by all boilers now in use, and they have withstood the hardest service for many years.

This water tube boiler can be sold at a moderate price, and is now manufactured by several of the foremost shops in Canada. The advertisement appears in this issue, and next month we will fully describe and illustrate the boiler.

MACHINES.[*]

A MACHINE is an instrument by means of which a force applied at one point is able to exert at some other point a force differing in direction and intensity. It has been usual in treating of simple machines to call the applied force the power, but the word power is now in use with an entirely different meaning, and so we shall accordingly speak of this applied force as the effort. The force exerted or effective resistance overcome is usually called the weight. This resistance may be the earth's attraction, as in raising a heavy body, or it may be the molecular attractions between the particles of a body as in stamping metal or dividing wood, or it may be friction as in drawing a heavy body along a rough road.

Besides the effective resistance, the effort is employed in overcoming the internal resistances chiefly due to friction which always exists between the different parts of a machine. The effort may be just sufficient to overcome these two kinds of resistance, or it may be in excess of what is necessary or it may be too small. If just sufficient, the machine once in motion will remain uniformly so, or if it be at rest it will be on the point of moving, and the force applied or effort will be in equilibrium with the effective and internal resistances. If the effort be in excess the machine will be set in motion, and will continue to move with an accelerated motion. If the effort be too small it will not be able to move the machine, and if the machine be already in motion it will gradually come to rest. When the effort is just sufficient to overcome the resistance, the ratio of the resistance to the effort is called the modulus of the machine. In this case it is evident from the law of Conservation of Energy, that the work done by the effort has its equivalent in the work done against the effective resistance to be overcome, and against the resistance due to the friction between the parts. This is the general law of machines in motion or in equilibrium.

The ratio of the effective resistance which we call simply the resistance to the effort is equal to the ratio between the distance through which the effort acts, and the distance through which the resistance is overcome at the same time ; or in other words, is equal to the ratio of the velocities of the points of application of the effort and resistance, or if we take equal distance and uniform motion, we see that what is gained in force is lost in time.

Simple machines, sometimes called the mechanical powers, may be considered under three heads : 1, a solid body movable around a fixed point ; 2, a flexible string ; 3, a hard inclined surface.

Under No. 1 come machines acting on a lever and wheel and axle, such as the crowbar, etc. In this case the difference between the power and fulcrum is greater than the difference between the fulcrum and weight. In the case of the wheelbarrow, row-boat, etc., the power is at one end, the fulcrum at the other and the weight between the two. In the human arm the weight is at one end, the fulcrum at the other, and the power between.

Under No. 2 come pulleys. In the case of the single pulley the power exerted must be equal to the weight; it simply changes the direction of the force. Where more than one pulley is used as in one block, the first one would support the whole weight, which we will say is 100 lbs., the 2nd pulley would support one-half of what is supported by the first, or 50 lbs., the third would hold or support one-half of what is supported by the second, or 25 lbs. ; the force therefore required to lift the 100 lbs. would only be equal to 25 lbs., but as it has already been said, what is gained in force is lost in time.

No. 3, inclined surfaces, includes the wedge and screw. To take a weight up an inclined plane, the weight and height must be equal to the power and length. In the screw, the power and circumference, equals the weight, and distance between threads.

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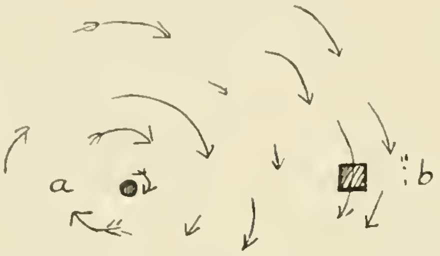
[*] Paper by Jas. Gill, Teacher in Physics at Normal School, read before Hamilton No. 2, C.A.S.E., January 11th, 1898.

ELECTRICITY IN MODERN BUILDINGS.

By "Electrician."

In the construction of a certain class of building a steel framework, filled in with stone or other material, is being very largely used, and as electricity is rapidly becoming the means of distributing light and power, and to some extent, even heat, throughout the halls, corridors, offices, etc., of any building which proposes to offer all the best modern conveniences, it may be worth while to consider whether there will take place any interaction between the steel framework, considered as a conducting network of comparatively low resistance, and the electrical circuits which distribute the lighting and power currents. It is, of course, evident that such a steel framework will offer a path of comparatively low resistance to any current that may be set up in it, and it is the purpose of this article to formulate those conditions which will tend to the setting up of such currents, and their physical effect on the building materials.

Regarded as a conducting network, currents may be set up in the steel framework by either induction or by direct contact (leakage being included as a contact). The diagram shows in section an electric light wire "a" through which a current is flowing, and a conductor "b" of some kind of conducting material—"a" and "b" being fairly close to each other, and more or less parallel during their length. At the instant of starting a current through "a" the whole space around "a" becomes an inductive field of rapidly increasing intensity, which will include the space surrounding "b," and this is a necessary and sufficient condition for the setting up of a current in "b," so that it will appear that actual contact is not required in order that a current may flow in "b". Similarly at the moment of stopping the current flowing through "a," a current will be induced in "b". If the current in "a" be stopped and started, or reversed in direction rapidly, or even made to wax and wane—that is, to merely fluctuate without actual reversal—currents will under all these conditions be induced in "b," and their strength will be proportional to: The conductivity of "b"; the strength of current in "a"; the rate of variation or fluctuation of the inductive field; the length of the conductor "b" that is in the inductive field—their distance apart. It is therefore conceivable that very considerable currents can be made to flow in "b" without any contact with "a." They will probably be currents of low voltage, but still capable of effecting considerable electrolytic damage. It is sufficiently obvious that contact between a conductor carrying current and a steel beam, whether it be direct mechanical contact or indirectly through a leak caused by damp, etc., will result similarly.



Suppose we have a steel frame building with a complete system of electrical distribution—for lighting, elevators, fans, heaters, etc.—it can easily be imagined that there may be set up inductively a most complicated and interlinked system of active currents in the various uprights and horizontals forming the frame, and that they may be of quite considerable magnitude. This can occur not only in the steel frame itself, but in the piping for the heating or auxiliary gas lighting services. With a direct current distribution for lighting only, these induced currents would probably have a negligible effect, as it is only at the moment of make and break that inductive action would take place, although even in such a case a direct current, though continuous in direction, will have sufficient very small fluctuations in strength (owing to the fact that the number of coils in the armature is not infinity) to keep up a continual alternating current in all the pipes and beams parallel to it and within the sphere of its influence. But in very many cases current is distributed for elevator and motor purposes, and here we find not only the small fluctuations due (as mentioned above) to the armature construction, but also that fluctuation due to the varying demands of the elevator and motor services, which, while not so rapid, will have an enormously greater ampitude, and so a much greater inductive influence. There are very many buildings, moreover, that employ an alternating current for lighting, the influence of which requires no pointing out. So that it appears that there will always be some circuits induced in such buildings, whether in the frame or the piping.

An electric current flowing in a circuit must produce one effect and may produce more. It must heat the conductor and may decompose it. The heat generated in the conductor depends on the amount of current flowing, and on the resistance offered to it, and in a circuit of varying conductivity the greatest heat will be generated at the point of greatest resistance. In a circuit composed of beams the points of junction will be those of highest resistance, and will therefore be the heating points. Just how far the expansion and contraction due to heating and cooling may be expected to work with the natural vibration to loosen the joints, is a matter that affords a very interesting field for discussion and experiment. But if it be granted that it does have the effect of so loosening them, then such loosening will tend to promote the decomposing action of the current flowing, with the assistance of whatever slight amount of moisture has condensed out of the atmosphere (or elsewhere) on the opposing faces of the loose joint. This latter action of the current is probably of greater importance than the former, as its tendency is to loosen by decomposition, and just where the utmost rigidity and permanence is desired, viz., in the foundations. The electrolytic injury would take place just at the base of a steel pillar, where the current was able to escape to earth, and the effect would be to eat away the metal, as the iron of water pipes is eaten away by the passage of railway currents. The electrolysis of gas and water pipes might be even a serious matter unless precautions be taken to minimize its effect.

While it seems impossible to so arrange as that there shall be no induced currents in framework or piping, still it is possible, and in most cases would be well, to adopt such precautions as will confine them within such small limits that they may become negligible. It would be well to thoroughly ground the entire steel structure by copper wires of large section leading from various points to the earth, and making good contact there with permanently moist soil. It would also be advisable in laying out circuits to so arrange that all those wires carrying the main current shall be as far removed as possible from any of the structure, and as close together as insurance regulations will permit. If it be necessary for the main wires to be close to a pipe or pillar, and to run parallel to it, then they should be placed one on each side of it so as to neutralize each other's effect.

PUBLICATIONS.

The publishers of Power, of New York, have eclipsed all previous efforts by their issue for December. It is replete with interesting articles on engineering subjects, while the advertisements many of them printed in various colors, present an attractiveness not often equalled. The frontispiece is especially worthy of mention.

The Canadian General Electric Company have issued an artistic lithograph calendar, in which blue and gold are the predominating colors. The figures of the calendar are large and clear. Above them is a female figure holding aloft in one hand an incandescent lamp, while with the other she draws aside a curtain, revealing in perspective a view of the company's works at Peterborough, Ont.

A valuable addition to the literature of British Columbia is the year book which has just been published by Mr. R. E. Gosnell, Legislative Librarian, with a copy of which we have been favored. Of the many works which reach our table, most of them of considerable merit, the credit for the most complete work of this character yet received must be given to the author of the British Columbia Year Book. Besides the facts and figures relating to the natural resources of the province, there is sufficient of an historical, political and sociological character to render the book interesting and instructive to all. There are over 500 pages of letterpress and illustrations, so arranged as to present a most pleasing appearance. To even mention the interesting features would involve more space than can here be given, suffice it to say that among them are the following: An historical review, including portraits of early navigators and explorers; a group of pioneers and early legislators; portraits of members of parliament; illustrations of government buildings; a treatise of 100 pages on mines and mining, with illustrations; a description of the fisheries and maps of different districts in British Columbia.

THE ARNPRIOR ELECTRIC LIGHT PLANT.

The power house of the Arnprior Electric Light plant is a substantial stone building, 70 × 40 feet, two storeys high, and fitted for both water power and steam, which may be used either separately or in conjunction. The water wheel is a 100 horse power turbine, and the engine a 100 h. p. Warwick. The boiler room is separated from the other rooms of the building by solid brick walls, fitted with fire-proof doors.

The generators consist of a Thomson-Houston 1,000 light generator and two Ball arc dynamos, the switchboard being fitted with Thomson-Houston instruments.

Mr. S. Sheppard.

One of the principal features of this plant is the fitting of the shafting with friction clutch pulleys, thus enabling the instantaneous throwing on or off of any of the machines. Another ingenious arrangement of the electrician in charge of the plant is a mirror suspended on a bracket at the side of the volt and ampere meter, with strong magnifying glasses on a swinging arm, so that the voltage can be read from any part of the room or from the outside of the doorway opening into the operating room.

The company have installed 24 arc street lamps and about 1,000 incandescent lights, and are giving a very satisfactory service.

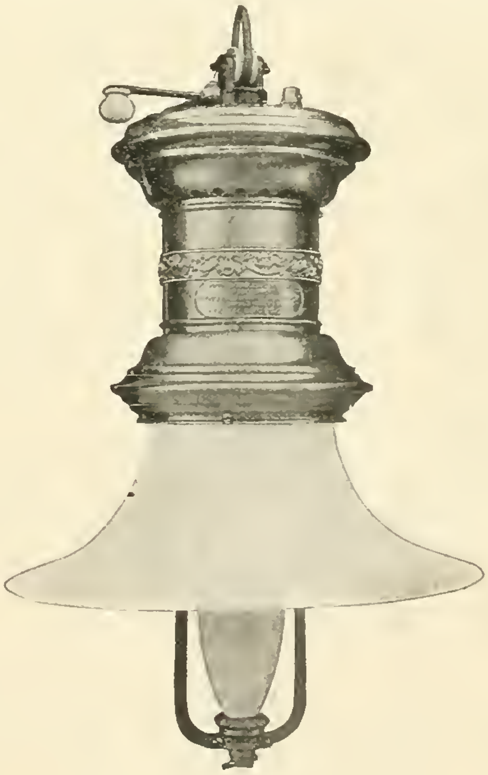
Mr. S. Sheppard, the electrician, whose portrait we present, is a native Canadian, and was born in Ottawa, May 11th, 1873. He is a thoroughly qualified electrician, and keeps the plant in first class condition. After leaving school Mr. Sheppard entered a machine shop, and after a couple of years entered the employ of the Ottawa Electric Co., with which firm he was engaged for five years, a greater part of the time in their repair and manufacturing department, leaving that company in April, 1896, to accept his present position.

FELT MATS FOR ENGINES.

Wool fibre seems to be about the only material that can be formed into a substance so firm and solid that it can be given the absurd name of "iron felt." In the manufacture of this material, London Engineering says that the best long wool fibre is first impregnated with petroleum grease, and further to a certain depth with glue, which is rendered insoluble by the addition of bichromate or formaldehyde ; in certain cases the surface is prepared with vulcanite rubber and then vulcanized. The stuff is very highly compressed and supplied in plates up to 2 feet square and more, from 0.4 inch to 2 inches in thickness. The plates are elastic ; withstand, according to tests conducted at the Reichsanstaldt, a pressure of about 9 tons per square inch ; do not rot, and the surface is said to be so hard that the edges of rails and bolts do not cut into it. The mats are placed under the rails of tramways, etc., in order to deaden the noise and clatter. For the same reason, a layer of this felt may be interposed between the foundations and the base plates of engines, and underneath the bearing of shafting in workshops. The mats must not overlap, and may be applied in layers. In the case of workshops it may also prove profitable to provide the respective joists and girders with mats. That the material is electrically an insulator would be an additional advantage. The chief question is, of course, whether the elasticity of the felt will last long enough to justify its practical adoption in engine rooms and workshops, where we do not like to risk experiments.

SINGLE GLOBE ENCLOSED ARC LAMP.

The Canadian General Electric Company, Limited, Toronto and Peterboro', has recently placed upon the market a new type of enclosed arc lamp, for indoor use, an illustration of which we give herewith. This lamp is made for both direct and alternating (60 or 125 cycles) circuits, and for three and five amp. currents. In many cases the three amp. lamp can be used with advantage, on account of the greater volume of light produced as compared with the double globe lamp. These lamps are handsome in appearance, and can be furnished in either black or bronze ornamentation. They are very desirable for all kinds of inside lighting, and their combined qualities of simplicity and economy should commend these new improved lamps to all central station men and owners of isolated plants. Further particulars can be obtained from the above company.


Single Globe Enclosed Arc Lamp.

The Robb Engineering Company, Ltd., of Amherst, N. S., recently suffered slight damage by fire. The loss is covered by insurance.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication to this Department not later than the 28th of each month.

TORONTO NO. 1.

MR. J. W. Marr, the popular secretary of Toronto No. 1, who had been in the employ of the T. Eaton Company for some time, has accepted a position in the power house of the Metropolitan Street Railway Company. His address is Box 155, Davisville.

The regular meeting of Toronto No. 1 was held on January 19th, when there was a good attendance and one initiation. The committee reported regarding the annual At-Home. It had been found necessary to draw on the Association funds for furnishing and decorating the hall, the insurance not being sufficient to cover the cost of the necessary repairs. On February 8th Mr. A. M. Wickens continued his lecture on "The Indicator."

On Thursday evening, Feb. 3rd, the Engineers' Hall, 61 Victoria street, was the scene of gay festivities, the event being the third annual At Home of Toronto No. 1. The engineers and their friends to the number of 150 had assembled there to participate in the evening's entertainment, which included a first-class musical programme, dancing, etc. The following contributed: Piano, Master Huggett; songs, Mr. Dimmock, Miss Lewis, Mr. T. Vice, Mr. G. T. Pendrith, Mr. Newton; reading, Mr. C. H. Fielding. The accompanist was Mr. A. E. Harding. Refreshments and an impromptu dance followed the above programme. The affair was quite a success.

TORONTO NO. 2.

A new branch of the Canadian Association of Stationary Engineers has been formed in Toronto, to be known as Toronto No. 2. On Saturday evening, January 15th, the following officers were installed by the Executive President, Mr. E. J. Phillip, assisted by the officers of Toronto No. 1: Past President, P. Trowern; President, John Dixon; Vice-President, John H. Venables; Recording Secretary, Thos. Graham, 570 King street west; Financial Secretary, J. Richardson; Treasurer, Joseph Hughes; Finance Committee, F. Tushingham, E. Thomas, T. L. Holmes; Trustees, John Dixon, J. McMulken, P. Trowern; Conductor, M. Connoley; Doorkeeper, H. Brown.

Immediately after the installation ceremonies, President Dixon delivered his maiden speech, and in conclusion invited the visiting brethren from Toronto No. 1 to partake of refreshments, when ample justice was done to the elaborate supper which had been prepared by the wives and daughters of No. 2.

BRANTFORD NO. 4.

At the last meeting of the Telephone City association, all the former officers excepting the treasurer were re-elected. General business comprised the chief work of the evening.

KINGSTON NO. 10.

At a recent meeting of Kingston No. 10, a committee was appointed to wait upon the members of the Dominion government to solicit their support in behalf of the Steam Boilers' Act, which provides for the proper examination of engineers and the inspection of boilers. The government will also be asked to appoint a resident examiner in the Kington district. Since the meeting, the Association have received the promise of the local members to support the bill, which will shortly come before the House.

TORQUE AND SPEED OF MOTORS.*

BEFORE we go into the matter of torque, it may be beneficial to go over, briefly, some of the units of electrical measurement:

FORCE is that which produces motion or change of motion in a body. The unit of force is that force which, when acting for one second on a mass of one gramme, gives it a velocity of 1 centimeter per second. It is called the DYNE. The force with which the earth attracts any mass is usually called the weight of that mass, and the force with which a body gravitates, i.e., its weight (in dynes) is found by multiplying its mass (in grammes) by the value of g.

WORK is the product of a force and the distance through which it acts. The unit of work is the work done in overcoming unit force through unit distance, i.e., in pushing a body through a distance of one centimeter against a force of one dyne. It is called the ERG. The force with which gravity pulls a mass of one gramme is 981 dynes (981 centimeters = 32.2 feet). Therefore, to lift a mass of one gramme through a distance of 1 centimeter is = 981 ergs of work or g ergs.

POWER is the rate of working. The unit of power is the WATT, and is = 10^7 ergs. per second.

1 foot = 30.479 centimeters.
1 lb. = 7000 grains.
15.432 grains = 1 gram.

$$\therefore \frac{7000}{15.432} = 453.59 \text{ grams, or } 1 \text{ lb.} = 453.59 \text{ grams.}$$

1 foot pound = g(30.479 x 453.59) = 13825 g ergs,
= 1357235 ergs.,
generally written 1.356×10^7 ergs.

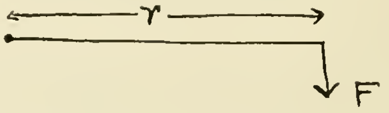
From which is readily deduced:

1 h.p. = 550 ft. pds. per second,

$\therefore$ $550 \times 1.356 \times 10_7$ = ergs in 1 h.p.,

but 10^7 ergs. = 1 watt,

$$\therefore \frac{550 \times 1.356 \times 10^7}{107} = 746 \text{ watts.}$$



Fr = Torque = T.
V = Velocity in centimeters per second.
F = Force in dynes.
W = Work in ergs.
N = No. of revs. per second.
W = Vf, but V = 2πr n.
$\therefore$ W = 2πr n f, but f r = Torque, $\therefore$ W = 2πnT.

As already stated, 1 pd. foot = 1.356×10^7 ergs, or 1.356 watts.

Since electric power is C E, and mechanical power is the speed multiplied by torque, we will now consider if there is any relation between the two.

$$\text{Watts} = \text{E C} = 2\pi\text{NT} \times 1.356$$

where E = EMF in armature
C = total current.

The E.M.F is proportional to the speed if the magnet flux N is constant.

$$\text{i.e., } E = \frac{\text{Rev. per second} \times \text{Nc} \times \text{N}}{10^8}$$

Where Nc = No. of conductors in armature
N = Total flux
E = 10^8 lines cut per second.

If we substitute the value of E in E.C we get

$$\frac{\text{R.p.s} \times \text{Nc} \times \text{N} \times \text{C}}{10^8} = 2\pi\text{NT} \times 1.356$$

but R.p.s = N = Rev. per second

$$\text{by cancellation we get } \frac{\text{Nc.N.c}}{10^8} = 2\pi\text{T} \times 1.356$$

$$\text{and by transposition } T = \frac{\text{Nc.N.c.}}{2\pi \times 1.356 \times 10^8}$$

By this we readily see that the torque T does not in any manner depend on the speed, but that it depends on the flux N and on the current, which shows very clearly that if we wish to make a motor have a large torque the flux must be large, and as this formula is applicable to generators, it shows that to make a slow speed dynamo generate the requisite E.M.F, N must also be large.

From the torque can easily be determined the total peripheral force, and from the peripheral force the pull on each conductor can be calculated, as follows:

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* Paper by Mr. James Milne, read before Toronto No. 1, C.A.S.E.

$$\text{Total peripheral force} = \frac{\text{Torque}}{\text{Radius in feet}}$$

$$\text{Average pull per conductor} = \frac{\text{Total peripheral force}}{\text{No. of conductors}}$$

As a rule the number of active conductors is $\frac{260}{360}$ of the total conductors ; those conductors in the gap of course are not cutting the lines and must be deducted.

$$\therefore \tfrac{260}{360} \text{ of total conductors} = \text{No. of active conductors}$$

$$\therefore \frac{\text{No. of active conductors}}{\text{Total peripheral force}} = \text{Pull in pounds on each}$$

The torque of a motor is a maximum when motor is standing still and gradually decreases, and is zero when the counter E.M.F is the E.M.F. of supply, which can be proved as follows :

$$\text{T (in dyne centimeters)} = \frac{\text{Nc. N.c}}{2\pi}$$

$$\text{but C in a motor is} = \frac{\text{E M F of Supply} - \text{Counter E M F}}{\text{R (Restance of Armature)}}$$

Substitute this value for C in the equation, and we get :

$$T = \frac{\text{Nc. N.c}}{2\pi} \times \frac{E^1 - E}{R}$$

but the counter E M F or E is precisely the same as in a generator = Nc. Rps. N. We are dealing in absolute units at present, and to bring this to volts or practical units would have to be divided by 10^8.

By substituting Nc. Rps. N for E, we get :

$$T = \frac{\text{Nc N}}{2\pi} \cdot \left(\frac{E^1 - \text{Nc. Rps. N}}{R} \right)$$

When $\frac{E^1 - \text{Nc. Rps. N}}{R} = E$, or when the C. E M F = E, there is no torque, or T = 0.

T is a maximum when $\frac{\text{Nc. N}}{2\pi} \left(\frac{E^1 - O}{R} \right) = \frac{\text{Nc. N. } E^1}{2\pi R}$, i.e., when there is no counter E M F, or in other words, when the motor is standing still and current on.

From the above we get :

$$T 2\pi R = \text{Nc. N (E} - \text{Nc. Rps. N)} = \text{Nc. N E} - N^2 c.\ N^2 \text{r.p.s.}$$

$$\text{r.p.s.} = \frac{\text{Nc. N E} - T 2\pi R}{Nc^2\ N^2} = \frac{E}{\text{Nc. N}} - \frac{T 2\pi R}{Nc^2\ N^2}$$

and to reduce same to practical units, we have :

$$\text{r.p.s.} = \frac{E \times 10}{\text{Nc. N}} - \frac{T 2\pi R \times 10^9}{Nc^2\ N^2}$$

The following example taken from actual practice may be found interesting : In a Fensom elevator the speed where $E^1 = 230$ volts, N = 1,400,000, current 60 amperes, 1000 conductors, find the torque.

$$\text{T in pound feet} = \frac{60 \text{ amp.} \times \text{Nc.} \times \text{N}}{108 \times 1.356 \times 2\pi} = \frac{840}{8.52} = 100 \text{ pd. ft., nearly.}$$

The resistance of the armature of this motor was .435 ohms, from which we could easily determine the revs. per sesond as follows :

$$\text{R.p.s.} = \frac{\text{E.M.F.}}{\text{Nc.N}} - \frac{2\pi T\ R}{Nc^2\ N^2}$$

The torque being given in pound feet, it must be reduced to dyne centimeters by multiplying by 1.356 x 107,

$$\therefore \text{ revs. per second} = \frac{230 \times 10^8}{1000 \times 1400000} - \frac{2\pi \times 1.356 \times 10^7 \times T.R \times 10^9}{1000^2 \times 1,400,000}$$

which when worked out give 14.5 revs. per second = 870 revs. per minute.

This motor is in the R. Simpson Co.'s store, running one of the elevators. For those who wish to go into this further, they are requested to consult Sylvanus P. Thompson or other good works on the subject.

The calculations are extremely interesting, and it can readily be proved that the maximum work that can be got out of a motor is when the current is one-half that which flows when the armature is standing still, and that the efficiency is one-half, or 50 per cent.

COMPARATIVE EFFICIENCY OF ILLUMINANTS.

Of the total energy supplied, a candle consumes 86 watts per candle ; oil lamp, 57 watts ; butterfly gas burner, 93 watts ; incandescent lamp, 3.5 watts ; arc lamp, .8 watt. Thus, if gas is used in a gas engine having an efficiency of 20 per cent., it will produce about five times more light from incandescent lamps than if burned direct in jets.

THE OILS OF THE ENGINE ROOM.*

Oil is the main factor in the reduction of that element of waste, friction, and in proportion as you apply oil of the proper kind and in the proper way, just so much do you economize in fuel, wear and tear, and consequently in the loss of power.

Oils are usually divided into two classes, drying and non-drying. To the latter class belong lubricating oils, which are the oils of the engine room. We will first consider the conditions under which the oils are applied. The first point that comes to our notice is that the oils are placed between two metal surfaces to keep them apart, and therefore the oils themselves sustain the pressure of the lever, at one end of which is the weight (which is the work of the machine) and the compounding power which is equal to the weight ; we find, therefore, that the oil has to withstand an enormous pressure according to the kind of machine it is in. As we have observed, the oil is between two metal surfaces which are very close together, and the deduction would be that the oil should be quite free from hard particles which might abrade these two surfaces. Usually one surface is hard and the other soft, and were particles of a gritty nature allowed to pass into the oil, the two surfaces—which we will after this call the bearings—the consequence would be that they would become inbedded in the soft part and would cut the hard surface or the shaft. The idea which you will gather from these remarks so far is that oils should be clean.

We will now come to find that we have another condition which will be as important as the previous one. The oil is used at two different temperatures, a low and a high temperature, the first cold bearings and the second hot bearings. We will consider the cold bearings first ; these include nearly all bearings, there being but three or four hot bearings on one individual engine, and taking the shaftings, hangers and all other journals as parts of the machine, by far the larger proportion are cold bearings. The temperature of an engine room will average 70 degrees, and the bearing will be exposed from this down, in cases of shaft passing from one building to another, or in processes where the buildings are not heated to zero. It will here be apparent that oil must be useful at low temperatures. You are all aware that certain oils are solid at the freezing point of water ; it would be plain to you that such a condition would prevent the oil moving to the point where it would be required even if the action of the parts would make it of use if it were in place. We must therefore require that oils should flow at the temperatures to which the bearings are exposed.

It is also required that oils should be stable at the highest temperature to which they will be exposed—allowing this to be 100 degrees, this being the temperature at the hanger level in a hot work room. Stable in that they will not evaporate and let the bearing go dry, which is called gumming. This is a characteristic of vegetable oils. It is also necessary that the oil should not turn rancid with the formation of acid and a consequent loss of lubricating quality. This is a condition which ensues with animal oils, also to some extent with vegetable oils.

We have up to this point considered the circumstances, conditions and requirements of the oils, and we have found that they should be clean, capable of withstanding pressure, workable at low temperatures, not volatile, non-drying, not rancid. Oils are divided under the following heads : Olive, cottonseed, linseed, palm, castor and fish oil.

(To be Continued)

A NEW COMBINATION OF STEAM ENGINE AND BOILER.

A new combination of steam engine and boiler is proposed by W. Schmidt, of Ballenstadt, Germany, the construction in this case being considered a valuable improvement on that class in which the cylinder of the engine is either partially or wholly arranged in the boiler. The objects aimed at and believed to be accomplished is for a steam boiler and engine capable of yielding a high effect, requiring repairs only at very long intervals and not necessitating continual attention. These advantages are attained by arranging the cylinder of the engine within the interior of the boiler, with the lower end projecting into the fire-box. The cylinder serves as a stay to the crown sheet. The engine is single-acting, and the valve is placed in the steam and water room of the boiler. Still further to secure efficient results by means of this arrangement, there are provided, in addition to the heating surface furnished by the fire-box, a number of drop tubes, which add very much to the steam generating capacity of the boiler.

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* Paper read at open meeting of Hamilton No. 2, C.A.S.E., January 18th, 1898, by J. W. Williams, chemist for Winer & Co., wholesale druggists.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By. Wm. Thompson.

[Article 2].

When we understand what is taking place during the act of pitting, it becomes comparatively easy to suggest a remedy. What is required here is a substance on which the corrosive agent can exhaust itself; and probably the best remedy is a slight coating of lime scale, which can be easily obtained by the use of lime water or milk of lime.

This theory has not, however, been universally accepted as the true cause of pitting (although in the writer's opinion it appears very rational). The cause of this trouble has been attributed by many writers to electrolytic action set up between the impurities of the iron and the iron of the boiler itself, which, being electro-positive to the impurities, gradually disappears while the impurities remain to further the disintegrating action. In support of this theory it became a common practice to suspend zinc in boilers subject to pitting and corrosion, on the assumption that since zinc is chemically more powerful than iron, it would become electro-positive to the iron and thus protect the boiler against electrolytic action at the expense of its own metal. If such is the case, then it becomes very necessary for us to note what may be expected to take place when zinc is suspended in the boiler as suggested.

To get as clear an understanding as possible of this process, let us briefly illustrate what takes place in a voltaic cell, which is practically what we are converting our boiler into with zinc and shell as electrodes and water and its impurities as electrolyties. To this end let us examine the process known as electrolysis, taking for example a dilute solution of hydric chloride, subjected to decomposition by means of electrolysis in a glass vessel so that process may be noted. We find chlorine evolved at the positive pole and hydrogen at the negative pole, the gases being perfectly pure and unmixed. If, while the decomposition of the hydric chloride is rapidly proceeding, we examine the intervening liquid carefully, no apparent movement or disturbance of any kind can be perceived, and nothing in the shape of currents in the liquid or transfer of gas bodily from one pole to the other can be observed, and yet two portions of the hydric chloride separated by two to six inches are actually seen to evolve pure chlorine and pure hydrogen.

There seems but one method of explanation of this singular phenomenon, which is applicable to all similar cases of electrolytic decomposition, and that is to assume that each of the particles of hydric chloride intervening between the electrodes or poles, and by which electric current is conveyed, simultaneously suffer decomposition, the hydrogen travelling in one direction and the chlorine in the other. The neighboring elements being in close proximity to each other, unite to again form hydric chloride and destined to be again decomposed by a repetition of same change. Thus it is each particle of hydrogen may be made to travel in one direction by becoming successively united to each particle of chlorine between itself and the negative pole; and when it reaches the latter, finding no disengaged particle of chlorine for its reception it is rejected, so to speak, from the series and thrown off in a free state.

Exactly the same thing happens to the chlorine which is travelling in the opposite direction, consequently a succession of particles of hydrogen are thrown off at the negative pole and a corresponding succession of particles of chlorine at the positive. The power of the current is exerted with equal energy in every part of the liquid conductor, though its effects become manifest only at the terminals. The action is purely of an internal nature, and the metallic electrodes or terminals of the battery simply serve the purpose of completing the connection between the latter and the liquid to be decomposed.

Like hydric chloride, all electrolytes, when acted upon by electricity, are split into two constituents, which pass in opposite directions. Substances of the one class, such as chlorine, iodine, oxygen, etc., are evolved at the positive pole, and those of the other class, such as the metals and hydrogen, at the negative pole. It is, though, important to remark that oxygen salts, such as the sulphates and nitrates, when acted upon by the current, do not divide into acid and basic oxide, but into a metal and compound substance or group of elements. Thus sulphate of copper ($Cu\,SO_4$) does not split into SO_3 and $Cu\,O$, but into metallic copper (Cu) and sulphione (SO_4) sulphuric acid ($H_2\,SO_4$) dividing into the same compound and hydrogen. In a similar way it is seen that the part of the electrolyte passing to the negative pole may be a compound consisting of several elements. An illustration of this change is the commonly used sal ammoniac ($NH_4\,Cl$) which is decomposed in such a manner that the ammonium (NH_4) goes to the negative pole, when it is resolved into ammonia (NH_3), the pure hydrogen and the chlorine going to the positive pole.

We must, nevertheless, draw a distinct line between true and regular electrolysis and secondary decomposition brought about by the reaction of the bodies eliminated upon surrounding liquid or upon the substance of the electrodes. When, for example, potassium sulphate ($K_2\,SO_4$) is electrolysed, hydrogen appears at the negative pole together with its equivalent quantity of potassium hydroxide ($K\,OH$), because the potassium which is evolved at the electrode immediately decomposes a portion of the water there present. The chemical reaction takes place as follows:

$$K_2 + 2\,H_2\,O = 2\,K\,OH + 2\,H.$$

At the same time the sulphione ($S\,O_4$) which passes to the positive pole takes up hydrogen by decomposing the surrounding water forming sulphuric acid ($H_2\,SO_4$) and liberating oxygen according to following reaction:

$$SO_4 + H_2\,O = H_2\,SO_4 + O.$$

In like manner the sulphuric acid itself is resolved by the current into hydrogen and sulphione, which latter decomposes the water at the positive pole reproducing sulphuric acid and liberating oxygen just as if the water itself were directly decomposed by the current into hydrogen and oxygen. This explains a circumstance that was very puzzling to our early experimentors upon the chemical action of a voltaic battery. The true source of these compounds was traced by Davy in 1807, who showed very clearly that they proceeded from impurities in the water, or the vessel which contained it, or from surrounding air. He redistilled water at a temperature below boiling, and found when marble cells were used to contain the water intended for decomposition hydric chloride appeared at the negative pole and sodium at the positive, but derived from sodium chloride present in the marble as an impurity. This manifestly proves that water in a pure state is not an electrolyte and is incapable of conveying current, but is enabled to do so if even a trace of saline matter is present.

We have now, I hope, clearly expounded the principles of the voltaic cell. Now, let us consider its practical application for the purpose we have in view. Suppose we have a wire conducting an electrical current; cut this wire and place both ends in a cell containing water to which we have added some sulphuric acid to add to its conductivity. It will be observed that bubbles of gas are forming on the ends of the wires. These bubbles are simply hydrogen and oxygen obtained as already described. Let us now select for our poles, zinc and wrought iron, to get as nearly as possible the conditions existing within our boiler. If our zinc is pure no perceptible action will take place on immersion in the cold solution. We next immerse our wrought iron plate, and find chemical action is at once set up, hydrogen bubbles rising and metal gradually wasting away. Let us now connect the two wires from the source of electrical energy to the dry ends of our plates, and a complete change of conditions at once takes place. The hydrogen will still be seen to rise from the wrought iron plate, but the plate itself will cease to dissolve. But the zinc plate will gradually disappear, and just as long as any part of it remains in contact with the water and in electrical contact with the iron, the iron will be protected from decomposition at the expense of the zinc. We can now, I think, perceive clearly the reason for the gradual wasting away of the zinc or positive pole. As the water is decomposed by the passage of the current, the oxygen is attracted to the positive pole, and being practically electrolytic, oxygen or ozone attacks the metals, very actively and destructively, and we find them more or less rapidly wasting away.

We have now before us information to enable us to understand the action of zinc in boilers, and can readily see that zinc can only be successfully used where certain conditions pre-exist. We must first have some solution that makes a good electrolyte, and next see that contact between zinc and shell of boiler is electrically good; further, we must be sure that galvanic action is set up within the boiler. I think it has been amply proven in engineering practice that galvanic action is set up within the boiler due to many causes, such as difference in temperature in different parts of the boiler, thereby causing a current, and generating electricity due to friction; also galvanic action is set up between the different kinds of metal used in and about a boiler, such as composite fittings and steel shell, etc. It is also quite possible to create galvanic action between different parts of the same boiler when a certain portion of the metal is homogeneous, while another is poorly made, due to bad iron, etc. In fact, galvanic action may be set up in a multitude of ways, and it is this very fact that makes the use of zinc in boilers, especially in fresh waters, rather to be condemned than approved, especially when action is not clearly understood. It has lately become a very common practice, especially in marine work, to purposely set up galvanic action within the boiler, by the aid of an external current, to prevent not only corrosion, but the formation of scale, and the system has met with a great deal of success, as it very properly would when conditions are favorable. Marine engineers are, however, exceptionally favored in this respect. Not only does their feed water contain a large quantity of saline matter, but also a certain proportion of free acid, making the solution within the boiler an excellent electrolyte; consequently they have only to see that contact between their zinc and iron electrodes is correct and galvanic action set up to secure good results.

The first essential required is a thorough knowledge of action of zinc in boilers, and secondly, a knowledge of conditions preexisting. Before leaving this subject I wish to point out to the reader that nothing but the purest zinc must be used. Ordinary commercial zinc contains many impurities, and especially must lead be absent. If lead is present it will be found after zinc has wasted away, and a new condition of things will exist; the shell of the boiler will become electro-positive and the lead negative, and the cure becomes worse than the disease.

GENERAL CORROSION.

This form of corrosion is in some localities a very common one, and is a peculiarly difficult one to explain in a general way. It is largely due to the presence of free acids, which may be present in the feed water, or may exist as a result of the use of some of the vile nostrums sold as boiler compounds, prepared frequently by people who do not know the first requirements of the substance they sell, except that it will take off scale. When carbonates are absent, free sulphuric acid may be present, especially in mining districts, and chiefly derived from the oxidation of pyrites and sulphides. This acid is also often found in streams passing through manufacturing districts, owing to the refuse from dye works, galvanizing shops, chemical factories, etc., having been discharged into them.

Another fruitful source of free sulphuric acid is the use of kerosene, which is now so commonly used. Kerosene is produced by one of a series of distillations of petroleum, and in its first and crude state is a turbid liquid, having a strong odor and a bluish tinge. To remove these, the refineries give the kerosene a course of treatment with sulphuric acid. Part of this, together with impurities, precipitates as a heavy black sludge. The purified oil is next treated with caustic soda, to neutralize any free acid, and then washed with water. Like many other processes of a similar nature, work is not always well done, and free sulphuric acid remains in solution. The oil itself vaporizes very readily when in the boiler and passes off with the steam. The sulphuric acid being non-volatile, remains behind, and finally becomes sufficiently concentrated to attack the boiler, and corrosion sets in.

A very prolific source of corrosion is also caused by the presence of hydrochloric acid in the water. This is a very fruitful source of trouble in waters containing magnesium chloride in solution, and is often caused in waters containing other salts of magnesia by the use of compounds which reduce salts of magnesia to magnesium chloride. At all temperatures of present boiler practice, magnesium chloride decomposes in presence of water in accordance with following chemical equation:

Magnesium Chloride.		Water.		Magnesium Hydrate.		Hydrochloric Acid.
$Mg.\ Cl_2$	+	$2H_2O$	=	$Mg.O_2H_2$	+	$2H\ Cl.$

Reference has been made to the formation of magnesium chloride, and consequently the liberation of hydrochloric acid by the use of compound resolvents. A striking example of this is the practice of adding sal ammoniac, $N\ H_4\ Cl.$, to the feed water to dissolve carbonate of lime, the reaction in this case being:

Sal Ammoniac		Carbonate of Lime.		Chloride of Lime.		Carbonate of Ammonia.
$2N\ H_4\ Cl.$	+	$Ca\ C_1O_3'$	=	$Ca\ Cl_2$	+	$(N\ H_4)_2\ Co_3.$

The final result is that a soluble salt added to a water containing an insoluble salt, the insoluble salt is rendered soluble, and consequently no precipitation takes place. Unfortunately, the reaction does not stop here; waters containing carbonate of lime invariably also contain carbonate of magnesia, and the following reaction is set up between the sal ammoniac and the carbonate of magnesia:

Carbonate of Magnesia.		Sal Ammoniac.		Carbonate of Ammonia.		Chloride of Magnesia.
$Mg.\ Co_3$	+	$2\ N\ H_4\ Cl.$	=	$(N\ H_4)_2\ Co_3$	+	$Mg.\ Cl_2.$

This latter salt undergoes a secondary decomposition as follows:

Chloride of Magnesia.		Water.		Hydrate of Magnesia.		Hydrochloric Acid.
$Mg.\ Cl_2$	+	$2H_2O$	=	$Mg.\ O_2H_2$	+	$2H\ Cl.$

The action of hydrochloric acid differs materially from the action of the sulphuric acid, owing to the fact that it volatizes very readily, and as a vapor passes off with the steam; thus, not only will the boiler itself be attacked, but also the steam pipes, and even the engine. This acid, at temperatures higher than boiling, even in dilute solutions, attacks iron very readily, and is a fruitful source of corrosion and its companion troubles.

Vegetable acids, or properly speaking, organic acids, while of a feebler nature, still attack iron to some extent, and particularly since these acids are derived from waters usually taken from swamps containing a great deal of vegetable organic matter with very little lime salts. In cold climates the water is also apt to contain a considerable quantity of free oxygen, which adds materially to the corrosive action of the acids present. The presence of the slimy organic precipitate common to waters of this class seems to add to, rather than retard, the work of corrosion.

Whole chapters might be written on the best methods of treating troubles of this kind, but I consider the best advice is to consult some one thoroughly trained in this particular subject, who is not only able to suggest a remedy, but can determine accurately the nature and cause of trouble, and the slight expense incurred will never be regretted.

(To be Continued)

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H. M.	H. M.	H. M.
1....	P.M. 11.50	A.M. 5.40	5.50
2....	" 12.00	" 5.40	5.50
3....	A.M. 12.40	" 5.40	5.00
4....	" 1.50	" 5.40	3.50
5....	" 3.00	" 5.40	2.40
6....	No Light.	No Light.	.....
7....	No Light.	No Light.	.....
8....	No Light.	No Light.	.....
9....	No Light.	No Light.	.....
10....	P.M. 6.30	P.M. 9.50	3.20
11....	" 6.30	" 11.10	4.40
12....	" 6.30	A.M. 12.20	5.50
13....	" 6.30	" 1.20	6.50
14....	" 6.30	" 2.30	8.00
15....	" 6.30	" 3.30	9.00
16....	" 6.40	" 4.20	9.40
17....	" 6.40	" 5.00	10.20
18....	" 6.40	" 5.10	10.30
19....	" 6.40	" 5.10	10.30
20....	" 6.40	" 5.10	10.30
21....	" 6.50	" 5.10	10.20
22....	" 6.50	" 5.10	10.20
23....	" 7.00	" 5 10	10.10
24....	" 8.00	" 5.10	9.10
25....	" 9.10	" 5.10	8.00
26....	" 10.10	" 5.10	7.00
27....	" 11.10	" 5.10	6.00
28....	" 11.10	" 5.10	6.00
29....	" 11.50	" 5.10	5.20
30....	....	" 5.10	4.30
31....	A.M. 12.40	....	
		Total......	188.60

A civil engineer has been examining the feed water of boilers, and has come to the conclusion that the presence of an acid in a boiler can be accounted for in this manner: Internal corrosion is not only caused by the acids with which some canal, pit and other waters are impregnated, but is also due to the acidity resulting from the decomposition, by high temperatures in boilers, of chlorides of lime, magnesia and sodium, and of sulphates of lime and magnesia, the former sometimes developing hydrochloric and the the latter sulphuric acid. If steps are not taken to neutralize these acids by introducing some substance for which they have a greater affinity than the material of the boilers, the latter becomes pitted or wasted more or less rapidly.

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Canadian Electrical Association.

IN our next issue we will inform our readers fully as to the excellent work done by the Committee on Legislation of the Canadian Electrical Association, and the progress made toward securing such changes in the law as will place electric and gas companies on a more equitable footing than they at present occupy with respect to municipal lighting.

Cheap Power.

AN indication of the economical possibilities of an up-to-date steam plant for the generation of electricity is to be seen in the offer of the Toronto Electric Light Co. to supply electric power, ten horse power and over, ten hours per day, at 2 cents per h.p. per hour. Such an offer is calculated to induce close figuring on the part of projectors of long-distance power transmission schemes.

Gigantic Electrical Undertaking.

AN electrical undertaking which has heretofore been unequalled in magnitude is about to be carried out in New York, and is attracting world-wide attention. It is the conversion of the overhead railway from steam to electric power, which will involve an estimated outlay of at least seven million dollars. Four of the largest manufacturing companies, namely, the General Electric, Westinghouse, Walker and Sprague, are now figuring on the proposition, which is calling into requisition the skill of the most talented engineers in the country.

Electrical Apparatus for the Parliament Buildings.

MUCH unfavorable comment has been made upon the action of the Minister of Public Works in awarding the contract for lighting the Parliament Buildings at Ottawa without inviting tenders. At the last session of the Dominion Parliament an appropriation of $75,000 was set aside for lighting the buildings by electricity and increasing the fire protection. It was generally supposed that the usual course of publicly inviting tenders would be followed, and that all Canadian manufacturers of electrical apparatus would be given an opportunity of figuring on the work. The government, however, considered it wise to enter into a private contract for four Westinghouse 40 horse power electric motors and four Worthington fire pumps, and also for the necessary current to light the building throughout. In justification of the course pursued, the claim is made that by the agreement entered into a saving of several thousand dollars a year will be effected. It is difficult to understand just how this estimate is reached. Granting that current can be purchased more economically than it could be generated by a plant placed in the buildings, there seems no reason why tenders should not have been invited for such apparatus as was purchased. This method undoubtedly secures the best results and gives most general satisfaction.

Power for Street Railways.

It has been rumored for some time past that the Montreal Street Railway Company were considering the question of buying the necessary power for the operation of their system. This report was recently strengthened by an inspection of the Chambly power plant made by Messrs. F. S. Pearson, chief engineer of the Metropolitan Traction Company of New York; E. H. Keating, manager Toronto Street Railway, and F. L. Wanklyn, manager Montreal Street Railway. These engineers will, it is said, make a report to the directorate of the company, and upon this will depend future negotiations. The Montreal Street Railway Company at present generates its own power, using about 9,000 horse power per day. The cost of producing this power is estimated at $42 per horse power, which represents an annual expenditure of over $360,000, while, according to reports, the Chambly Manufacturing Company have offered to furnish the necessary power at $32 per horse power. This would mean an annual saving of $90,000. Granted that these figures are correct, the saving thus effected would very soon pay for the street railway plant now utilized, and which would have to be discarded or sold at a great reduction below first cost. It might, however, be found necessary to retain the plant as an auxiliary.

Some Important Experiments.

Professors Callender and Nicholson, of McGill University, Montreal, have been making some experiments in connection with the steam engine which promise to be of great practical value. They have presented to the English Institution of Civil Engineers a paper on the subject, which we hope to publish in our March issue. The object of the experiments was to ascertain the exact temperature of the steam in the cylinder at different points of the stroke, it having been known to change as much as 100 degrees Fahrenheit in one second. These changes were too rapid to permit of being recorded by mercury thermometers. Professor Callendar has, therefore, devised an electrical resistance thermometer, by means of which it is possible not only to ascertain the temperature at any point of the stroke, but to follow it exactly throughout its entire course. The thermometers are fixed both inside the cylinder walls and in the head of the piston, and as the latter is carried up and down, continuous readings on the galvanometer can be observed. The professors are now continuing their experiments on the large compound engine in the Montreal Street Railway Company's power house, which is probably the largest engine in the world coupled to a single generator. This engine is said to be well adapted for test purposes on account of the very complete arrangements for steam-jacketing the various parts of the cylinders. Some valuable as well as interesting results may be expected.

Improved Conditions.

The business outlook in Canada at this moment is most encouraging. The combination of a bountiful harvest with unusually high prices for agricultural products appears to be the greatest factor in bringing the return of prosperous conditions. The rich gold discoveries of the Klondyke have turned the eyes of the world towards Canada, and as a result the tide of immigration and of capital is beginning to flow into the Dominion. The period of more rapid advancement which Canadians have been looking and hoping for is undoubtedly at our doors. We should keep in mind the words of Shakespeare, "There is a tide in the affairs of men which, taken at the flood, leads on to fortune." This is true of nations as well as of individuals. Every advantage should be taken of the unusually favorable conditions now prevailing to push forward the development of the nation, its commerce and industries. Comparatively good progress was made by the electrical industries even during the recent period of depression, but a large number of projected undertakings could not be proceeded with owing to the difficulty of securing the required capital. It may fairly be anticipated that, with capital seeking investment, many of these enterprises will go forward to completion during the present year. The electric railway field is by no means fully occupied, but is capable of great extension. The city of Toronto might well be made the centre of a system of radial lines, which would make it the trade centre of a large and wealthy agricultural district. Electric railways intersecting the country in all directions, having facilities for the transportation of both passengers and freight, would be a most effectual check upon exorbitant freight and passenger charges by the two great steam railroad corporations. If this object is to be served, however, care must be taken to prevent the absorption of the electric by the steam roads. In the matter of electric power transmission Canada already stands in the very front rank, and we look for the utilization in the near future of many valuable water powers which are available for this purpose in all parts of the Dominion. Constant development and improvement is taking place in electric lighting, notwithstanding that only by the exercise of the greatest skill and economy can a reasonable return be secured from the capital invested.

A remarkable instance of the efficiency of roller bearings was recently made on a steel wheel weighing 130 pounds and 14 inches in diameter, which was speeded up to 10,000 revolutions per minute, and continued revolving one hour and a half after suddenly disconnecting the source of power. This was accomplished with absolutely no detriment to the bearing, when the plain bearing would have been ruined under such conditions.

THE RELATIONS BETWEEN THE CUSTOMER, CONSULTING ENGINEER AND THE ELECTRICAL MANUFACTURER.*

By S. Dana Greene.

The subject which I have chosen for this paper is an eminently practical one, and I shall endeavor in my remarks to call attention to certain causes of friction which at present exist between the parties in interest, and to suggest certain remedies which may serve to bring about a better understanding and to lessen this friction, which is, in my opinion, entirely unnecessary.

In order to discuss intelligently present conditions, it is advisable to trace briefly the development of the electrical business, and to do this one need hardly go back more than a dozen years. At that time electric lighting was still an experiment (from the commercial standpoint), electric railroading had not begun, and electric power transmission was discussed as one of the possibilities of the future. Very few of our institutions of learning had established separate electrical courses, and such a thing as a consulting electrical engineer hardly existed in this country. The few men who had some theoretical knowledge were eagerly caught up by the manufacturing companies, who had difficulty to find men capable of solving the many pressing practical problems with which they were confronted when they began to sell electric machinery. Thus the development of a practical generator and incandescent lamp immediately created a demand for suitable conductors and materials for outside and inside wiring, safety devices, etc., as well as close regulating engines, proper station appliances and many other things which are to-day regarded as "standards" in the business. It was less than a dozen years ago that the first fireproof switchboard was installed in the Broadway Theatre. The specifications were drawn by a consulting engineer —a naval officer by the way—calling for a fireproof structure, and the manufacturer no doubt accepted the order thinking that he could use what had always been used before, viz., a wooden framework. In this he was mistaken, however, and after a year's wrangling a slate board was installed, much to the manufacturer's disgust, and at great expense to him. It is hardly necessary to say that this form of switchboard became standard immediately, and several years after, the manufacturer, happening to meet the naval officer, said to him, "Someone was a d——d fool about that switchboard, and you were not the man." I well remember when I left the navy to join the Sprague Company in June, 1887, I found that the technical force of the company consisted of Mr. Sprague, an ex-naval officer, and Lieut. Crosby, who had just left the army. Upon explaining to the former how modest was my store of knowledge on the subject of "electric street railways," he at once assured me by saying that we were all in about the same boat! My opportunity came sooner that I expected when, about July 1st, I was charged with the execution of a contract for the equipment of a 40-car road in Richmond, Va., which, under the terms of the contract, was to be in full and complete operation on the first of the following October.

Doubtless most of those present to-night can recall the remarkable growth of electric lighting and railway work during the next five years, from 1887 to 1892—a growth that can fairly be called tropical. Plants sprang up in nearly every city and town in the country, and manufacturers sprang up with equal rapidity. There seemed to be unlimited money ready to invest in electrical enterprises, and the anticipated profits were such as to make the old established manufacturing industries seem very poor investments. During this period, which may be called the "forced expansion period," purchasers usually had to take what they could get, and consulting engineers were few and far between. Specifications for apparatus or installations, when there were any, were generally prepared by the manufacturer, and the purchaser rarely knew whether they had been fulfilled or not. By the close of this period, however, the colleges and technical schools began to turn out men who had taken special courses in electricity and who naturally looked for a chance to make an honest living. The first great demand of the manufacturing companies for technical assistants having been satisfied, many of these young men found their way into local operating companies, or else established themselves as consulting or contracting engineers, in which positions they found plenty of work, for by this time the imperfection in the earlier installations and types of apparatus had become plainly evident to the purchaser as well as to the manufacturer, and there was a general demand for better workmanship and more rigid requirements in installation. It may be here noted that much of the "anticipated profit" of the business, both of the operating and manufacturing companies, was spent subsequently in making good these early defects, and while the business as a whole profited largely by this reconstruction process, it naturally dampened the enthusiasm of the early investors.

In 1893 came the panic, and for the past four years there has been a wonderful record of savings and economies, both in electrical manufacturing and operating companies, as well as a great improvement in quality of product. It has been, in fact, the "economic and reconstruction period." The operating companies have learned that they, too, are manufacturers of a product, electricity; and as these hard times have forced down the price of their product, they, like the manufacturers of apparatus, have to keep their heads above water and their companies out of receivers' hands by the introduction of more economical and improved methods of manufacture and of administration. During the past year there has been a marked improvement in the electrical business; it is to be hoped that this improvement is permanent, and that the past four years of retrenchment and economy have paved the way for a normal and steady growth on conservative lines—in other words, for a period of "natural expansion." The business to-day is on much the same basis as in other industries, where prices are close, competition keen, and where a better article is furnished for less money than ever before.

The manufacturers of apparatus and the manufacturers of current are dependent upon each other to a large extent, and their relations should be close and friendly. The consulting engineer, as in other engineering trades, is a necessary and proper connecting link between the two, and I can say frankly that I believe he has a proper and permanent field of usefulness. Broadly speaking, his function is to see that his client who buys apparatus and installs it selects, first, that system best suited to his particular local conditions, and then, in purchasing, secures the best—not necessarily the most—for his money. It is equally the duty of the consulting engineer to learn what the manufacturer can reasonably be called upon to make, to consult with him freely and to obtain the benefit of his experience; to give him credit for work well done, and to insist that bad work shall be promptly corrected. Many consulting engineers, especially those who have recently commenced practice, seem to think that it is improper for them to consult with the manufacturer, or to examine his plant, or to ask him for information or advice. Their idea seems to be that, by so doing, they may be accused of partiality or undue bias, or with lack of proper care for the interests of the purchaser; or they may feel that it is derogatory to their own dignity as independent engineers. The inevitable result is that specifications often contain provisions which are a source of annoyance and expense to the manufacturer and purchaser alike, and which have no compensating advantages from either the engineering or commercial standpoint. In fact, some of these provisions are impossible or impracticable of fulfillment; and in such cases the honest manufacturer who wishes to meet the specifications and guarantees required finds himself forced to ask the engineer or the purchaser (sometimes both) to modify them. This is a proceeding which is always difficult and delicate to undertake, and often results in friction and trouble for all concerned. I am satisfied that if every consulting engineer would take advantage of opportunities as they occur, to visit manufacturing establishments, see the work there in progress and confer with the engineers, he would find himself well repaid for the visit, and his own work and practice benefitted thereby. I am equally satisfied that no reputable manufacturing establishment would refuse admittance, but on the contrary would welcome such visits as beneficial to both parties. The day of mysterious methods of manufacture, carried on behind closed doors, is passed in the electrical business, and I appeal with confidence for an indorsement of the opinions just expressed, to those consulting engineers who have already tried the plan suggested. I have said that I thought the engineer would find himself repaid by such visits. I think, also, that he will find himself in a better position to advise his client intelligently. A purchaser usually knows little or nothing of the relative technical merits of apparatus, and his final decision is governed largely by price and by paper statements and guarantees, which may mean much or little. The consulting engineer who has seen the apparatus in process of manufacture can advise not only as to whether the various bids comply with the specifications, but also what make or makes of apparatus are, from their design, construction and factory inspection and test, most likely to give the least trouble and expense in continuous service.

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Some engineers seem to measure their value to the purchaser by the length of their specifications, and some of these formidable documents strike terror to the heart of a busy man confronted by a desk full of mail. The specifications not only specify what the conditions of service are, what apparatus is required and what tests shall be applied to it for acceptance, all of which are quite proper, but also how it shall be built, which is another matter. The electrical manufacturers of this country, following the admirable precedent which has given American manufactured products (particularly machinery) a world-wide reputation, have endeavored to establish standard lines of apparatus, whenever the permanency of type and the size of the demand warrant it. This practice not only tends to reduce cost (and with it price), but also enables the purchaser to secure quickly and at a minimum of expense duplicate parts which are really duplicates, and which can be fitted without the aid of a skilled mechanic. It is the American system of standard lines of machinery and interchangeability of parts, which has stood the test of time and which holds its own against all competitors. This system, however, is possible only where the same article is manufactured in quantity, since the expense of designs, drawings and patterns, special tools, jigs, dies, etc., is prohibitive unless spread over a large production. On the other hand, if special apparatus is required it means a relatively large expense for these items, which cannot be charged to a standard product, and which thus constitutes a handicap both to the manufacturer and the purchaser. A machine is "standardized" only after long experience, both in manufacture and service, and other manufacturers (the builders of engines, trucks, etc.) as well as the users, are invariably consulted before such standardization. It would appear to be to the interest of both seller and buyer to use such standard machines wherever and whenever possible; and yet it seems to be a fact that the demand for special machines is increasing, rather than decreasing, as apparatus becomes more generally standardized. To prove this I can cite the experience for the past year of one manufacturing company with which I am familiar. During this period the designing engineers were called upon for estimates on special apparatus as follows:

Direct current:	
Number of estimates	300
Number of kilowatts of apparatus involved	31,000
Alternating current:	
Number of estimates	300
Number of kilowatts of apparatus involved	131,200

These estimates were all embodied in formal propositions. Besides these there were between two and three times as many preliminary estimates required to answer inquiries of customers, which the engineers had to prepare.

This was in addition to their regular work on standard lines of apparatus, of which there are over thirty. Some of this work was undoubtedly due to new developments in the business and to new methods and inventions, a condition which, although unfortunate from the manufacturing standpoint, must exist for many years to come; but a great deal of it was also due to the fact that specifications call for special apparatus, or methods of construction, where standard apparatus and methods would do equally well. This experience I find is common among electrical manufacturers, and I attribute it largely to lack of touch between the manufacturer and the engineer drawing the specifications, whether he be regularly employed by the purchaser, or retained in an advisory capacity. Let the engineer see more of the manufacturer and his work, and let him hold the latter responsible for results, as determined by proper tests, leaving the details of construction where they belong—in the manufacturer's hands.

G. T. Simpson, electrical supplies, Hamilton, is reported to have assigned to J. W. Vandyke.

Messrs. Hodge & Walley, of Sherbrooke, Que., want tenders for the supply of 50,000 electric railway ties.

The Canadian General Electric Company recently issued a writ against the Street Railway Company of Brantford for $230,000, on an old construction account, and judgment has been secured for the amount and placed in the sheriff's hands for execution.

SPARKS.

The British Columbia Oil Co., Vancouver, B. C., has been incorporated.

An electric light plant has been put in the St. Francis Xavier College, Halifax.

An electric light plant has been installed in a new summer hotel at Gore's Landing, Ont.

The Bushnell Oil Co., at Sarnia, Ont., now have their works lighted by a private electric light plant.

The Hull Electric Company have placed an order for five new summer cars with the Ottawa Car Company.

The Mountain Tramway & Electric Co., of Victoria, B. C., is seeking incorporation. The C. P. R. is interested.

The capital stock of the Yarmouth Amalgamated Telephone Company has been increased from $10,000 to $25,000.

The toboggan slide constructed by the Hull & Aylmer Electric Railway Company, at Aylmer, Que., is said to be well patronized.

The Welland Aqueduct Power Company has been organized, with a capital stock of $24,000, to supply electricity for light, heat and power.

The C. O'Dell Electric Light Company, of Annapolis, N S., is seeking incorporation. The company consists of Carman O'Dell, Jos. Foster, and others.

J. W. Robbins, one of the engineers at Beatty's foundry, Welland, Ont., died suddenly of heart failure shortly after returning from his work on Tuesday, December 4th.

The city engineer of Halifax, N. S., has been making surveys with a view of ascertaining where a sufficient water power can be obtained for operating an electric light plant.

The electric light company of St. Stephen, N. B., has purchased a 275 h. p. engine and three 100 h. p. boilers. This plant will be utilized upon the failure of the water power.

The Hamilton city council have resolved to engage an expert to examine the boilers at the city hall, with a view to putting in such apparatus as will reduce the consumption of fuel.

The Taylor Hydraulic Air Compressing Company, of Montreal, are installing a 500 h. p. plant at Ainsworth, B. C. The power is to be distributed to mines within a radius of five miles.

The taxpayers of Barrie, Ont., have voted in favor of purchasing the waterworks by arbitration. It is thought that an agitation for municipal control of electric lighting will follow this movement.

Acetylene, it is said, can be neither manufactured nor sold in Great Britain now save by express permission of the Home Secretary, the prohibition being made in a recent order-in Council.

Messrs. John Starr, Son & Co. have lately equipped an electric light station at Antigonish for Messrs. MacCurdy & Co., of that town, and are now fitting up the light in a number of stores and houses.

The Massey Station Telephone Company propose to construct a telephone line from Spanish Station to Spanish Mills, Ont. Henry L. Glover and T. J. Millen, of Massey Station, are interested.

A company has been formed at Maniwaki, Que., for the purpose of supplying electric light. The directors are: Messrs. Chas. Logue, J. P. Trambley, Dr. Mulligan and Rev. Father Laporte.

The National Carbon Company, of Cleveland, Ohio, manufacturers of carbons and battery cells, have favored us with a copy of their calendar for 1898, which contains also the moonlight schedule for the year.

Doran's new hotel at Windsor, now nearly completed, is being fitted up by John Starr, Son & Co. with an entire outfit of electric light wirings and fittings, as well as electric annunciators and bells and speaking tubes.

The Montreal Belt Line Railway have established a freight office at Moreau street, Hochelaga, for transportation purposes. This is likely to prove a great accommodation to farmers and others shipping produce to the Montreal market.

The Bell Telephone Company of Canada has announced the connection of its system of long distance lines with that of the American Telegraph and Telephone Company and other telephone companies in the United States, thus establishing telephone connections with Boston, Portland, New York and intermediate points.

It is reported that an effort will be made at the coming session of the Manitoba legislature to remove from the municipal act the clause which prevents the citizens of Winnipeg from voting on a Sunday street car by-law without the consent of the legislature.

The Berlin Telegraph of recent date says: The extension of the Galt and Preston Electric Railway to Berlin is likely soon to be an accomplished fact. Mr. Todd, the president, states that the work on the proposed extension will be commenced with the least possible delay.

McLaughlin & McDiarmid, of Lindsay, Ont., have given notice of application for the incorporation of the Tamagamingue Railway Company, to construct a steam or electric railway from a point on the C. P. R. in the townships of Springer, Caldwell or Kirkpatrick, to some point on Lake Tamagamingue.

The Electric Storage Battery Co., of Philadelphia, has just closed a contract with the Chicago Edison Company for a storage battery plant with a capacity of 7,436,800 watt hours. This will be the largest battery installation ever made. The contract includes switchboard and all the auxiliary apparatus, and will be completed in March, 1898.

Mr. D. A. Starr, manager of the Cornwall Electric Railway Company, submitted to the town Council of Peterboro', Ont., at its last meeting, a scheme for the construction of an electric railway from that town to Chemong and Lakefield. The company propose to lease the Chemong and Lakefield lines from the G. T. R., convert them into electric roads, and take over the freight business. The cost is roughly estimated at $350,000.

Dr. E. J. Edgar, of North Hatley, has formed a partnership with W. O. Roy, of Montreal. They have acquired a water power on the Massawippi river, a little below the village of that name, and purpose furnishing electric light and power to North Hatley, Eustis and Waterville. A contract has been made with the Jenckes Machine Co., of Sherbrooke, Que., for developing the power, and the whole plant will be put in at once.

John Starr, Son & Co., Ltd., Halifax, are now fitting up the St. Mary's Cathedral with a system of electric lighting which is said to be the most perfect of any hitherto installed in Canada. The wires, which have double insulation, are enclosed throughout in enamelled steel tubing, and the fittings are most elaborate. When completed this, with the decorations and artistic paintings lately finished, will make St. Mary's one of the handsomest church edifices in Canada.

In his inaugural address to the City Council of London, Mayor-elect Wilson stated that as the contract for electric street lighting would expire during the year 1899, he considered it expedient to secure all information possible on this question with a view of submitting to the ratepayers a by-law to provide for the corporation undertaking the work of furnishing its own light. In his opinion a committee should also be appointed to report on the advisability or otherwise of renewing the Bell Telephone Company's franchise.

The Edison & Swan United Electric Light Company, of London, Eng., are introducing a new high efficiency incandescent lamp, which takes 2¾ watts per candle, and has a practically constant efficiency and light during its whole life of between 400 and 500 hours. In short, the "smashing" point is said to be never reached with this lamp, as the filament ruptures before the light has sensibly diminished. At present the new lamps are made only in the 16 candle-power size, but the other standard sizes will shortly be put on the market.

Mr. W. Hawley, who is interested in the application of electrical power to canal transportation, states that electricity will be introduced as the motive power upon all the canals of the state of New York, the Champlain canal to be the first to be equipped. At the next meeting of the Board of Directors of his company he will recommend the offer of a prize of $25,000 for the best plan submitted for the utilization of an electric current to the propulsion of the canal boat. The electric current is to be transmitted in armoured cables in the ground along the canal lands.

The Crow's Nest Pass Coal Company is said to have given out orders for electrical coal mining machinery in the cities of Montreal, Toronto and elsewhere, to the value of $100,000, while the company will also erect about fifty beehive coke ovens at Coal Creek for the purpose of supplying the article to the proposed smelter at Robson, B.C. Mr. Blackmore, chief manager of the company, has visited the leading mining centres in the

United States and Canada, with the result that the most improved electric coal cutting machinery will be started in the Pass mines.

The annual meeting of the Montreal Telegraph Company was held in the city of Montreal on the 13th ultimo. The annual report presented showed assets of $2,263,030 and an excess over shareholders' capital of $151,823.85. The contingent fund was stated to be $70,869.11, and a resolution was passed that when the contingent fund reached such a figure that it would yield an annual revenue of $5,000, then this amount should be divided among the shareholders. A dividend of $40,000 was declared, and directors elected as follows: Andrew Allen, president, Hector Makenzie, Jesse Joseph, William Wainwright, Henry Archibald, Wm. J. Wilhall and Hugh. A. Allan.

The power house at St. Henri, Que., erected about five years ago by the Citizens' Light and Power Co., but recently purchased by the Lachine Rapids Hydraulic and Land Co., was totally destroyed by fire last week. It was a one-story brick building 125 feet long by 40 feet in depth, with boiler house in the rear. Through this building the current of the Lachine Rapids Hydraulic and Land Company was distributed to the various suburbs and to the city. The machinery included nine arc light machines, three incandescent machines, motors, exciters, engines and boilers, the whole being valued at $100,000. No decision as to rebuilding has as yet been announced.

A dispatch from New York states that one of the most remarkable conversations on record recently took place in that city. It was carried on over a telephone wire. At one end of the wire was Captain Charles Jacques, superintendent of the Holland Submarine Boat Company, in the New York office of that concern. At the other end of the wire sat Simon Lake, in the cabin of the submarine boat Argonaut, eight miles out in Baltimore harbor and sixty-five feet under water. A fairly stiff gale was blowing up above, but Mr. Lake's wonderful craft crawled along steadily on its submarine way, paying out its cable as it went, and Mr. Lake's voice could be heard in New York just as clearly as if the speaker was on dry land.

An electric horn has just been placed upon the market which is capable of making a prodigious noise, sounding much like a marine fog horn. This electric horn is the invention of Mr. A. Trudeau, of Ottawa. The need of a horn of this kind suggested itself to the inventor after the late disastrous fire at the Ottawa College, where a serious calamity might have taken place had the fire occurred at night. These electric horns, of a specified size, may be utilized as a morning signal or a fire alarm for waking pupils in the dormitories of scholastic institutions, or for any other purpose where a whistle might be used where there is an electric current available. The horns can be placed in different parts of a building and all set tooting at once by turning on the current.

In order to ascertain whether higher voltages could be commercially employed, the high tension plant at Utah was experimentally run for a couple of days at the extraordinary high voltage of 30,000 volts. The length of the line was 73 miles, and the test lasted 72 hours, during the most trying climatic conditions, comprising heavy rain and severe lightning storms, during which the lightning arresters discharged repeatedly, but without causing a flickering in the light circuits. The line runs normally at 15,000 volts, but the transformers were connected up to give 30,000. No trouble in the insulation was experienced. Over 1000 horse power was delivered over the 73-mile line with a loss of but less than ten per cent., including the transformers at both ends.

According to newspaper reports an important discovery was made by the Bell Telephone Company while testing wires in the city of St. Louis, Mo. It is claimed that the electric current operating street cars can be taken from the earth into which it passes from the rails, and used again for light and power without the use of special electrical machinery. No dynamos and converters are necessary. General Manager Durant, of the Bell Company, said: "That the current from the street car ground wires remains in the earth, and travels underground, we have demonstrated beyond a doubt, and we are certain this force can be used again. We find that a single wire with the simplest kind of a connection will suffice to produce light from this earth current. I can see no reason why the current could not be carried through motors and dynamos in the same way. If the actual current as it comes from the earth were not sufficient it could first be gathered into storage batteries and thus intensified."

PERSONAL.

Mr. Wm. Kennedy, a well known engineer of Kingston, Ont., died in that city on the 27th ultimo, of pneumonia, at the age of 61 years.

Upon the occasion of his recent marriage, Mr. A. Lafebvre, of the Comptroller's staff of the Montreal Street Railway, was waited upon by a large number of confreres and presented with a complimentary address and well filled purse.

The friends of Mr. George C. Robb, chief engineer of the Boiler Inspection & Insurance Co., will regret to learn that he has been indisposed for some time past as the result of an accident just before Christmas. Mr. Robb was rendered unconscious by a fall on an ice covered sidewalk, and is still suffering from the effects.

We are pleased to announce that Mr. J. A. Kammerer is now believed to be on the road to recovery. His illness, referred to in our last issue, has been of a most critical nature, and until about one week ago his recovery was somewhat doubtful. It will require several months to entirely overcome the ravages of the disease and regain his former health.

While on a visit to Hamilton recently, Mr. John Knapman, manager of the Bell Telephone Company at Peterboro', Ont., was being shown through a large warehouse, when he stepped on the false flooring of the elevator shaft, which gave way, precipitating him to the basement, a distance of 40 feet. Mr. Knapman was badly shaken up, but no bones were broken. His companion, Mr. Peter Hamilton, of the Peter Hamilton Manufactur-Co., received injuries from which he died in the hospital a few hours later.

LEGAL.

The Court of Review has confirmed the judgment of the Superior Court in the case of Richmond County Electric Company vs. Sherbrooke Telephone Co. The plaintiffs claimed that the defendant company erected poles in the town of Richmond for their telephone business, and strung wires thereon across and about one foot above plaintiff's wires. The plaintiffs alleged that the defendants allowed their wires to remain in dangerous proximity to plaintiff's wires, and that defendant's wires had sagged and come in contact with those of the plaintiff, producing a short dead circuit, by which plaintiff's dynamo was wrecked and other damage caused. The Electric Light Company were awarded damages of $218.

Wallace vs. City of Ottawa.—Judgment on appeal by plaintiff from judgment of Meredith, J., at the trial at Ottawa, dismissing the action which was brought against the city corporation and the Ottawa Electric Street Railway Company for damages for injuries sustained by plaintiff by reason of the alleged negligence of one or other or both of defendants on the evening of the 7th December, 1896, whereby plaintiff was overtaken and run into by a tramway car in Sparks street, in the city of Ottawa, there being a very narrow passage for foot travellers between a fence erected outside the sidewalk, where there had been a fire, and a tramway line and an obstruction on the passage, and no warning having been given of the approach of a car. Plaintiff contended that there was negligence of both defendants, no contributory negligence on the part of plaintiff, and abundant notice to defendants of the condition of the roadway, etc. The learned judge, while dismissing the action, assessed the plaintiff's damages at $350, and directed a reference as to damages for loss of business, etc., in the event of an appellate court finding negligence proved. Appeal dismissed with costs.

HE KNEW IT WAS HER.

Mr. and Mrs. J. came to town the other day, says a Louisville paper. The madam is a large, muscular-looking woman, and is evidently the boss of the ranch, while Mr. J. is a cowed, effeminate-looking creature, who seems to be afraid when the madam is around. While Mrs. J. went into Goldnamer's to do some shopping, the little man slipped off to Bell's to get a drink. While he was down there he heard the telephone ring and enquired what it was. The mysteries of the instrument were explained, and Mr. Bell offered to call up his wife at Goldnamer's and let him talk to her. This seemed to please him very much, but just as he got the trumpet to his ear the lightning struck the wire and knocked him down. Staggering to his feet he said, "That's her; it sounds just her."

Rev. John Wilson, of Fitzroy Harbor, Ont., in renewing his subscription, writes: "Although I take several New York electrical journals, I do not like to be without the Electrical News."

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications fron time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE X.]

DROP IN POTENTIAL AND SIZE OF LEADS FOR MULTIPLE ARC CONNECTIONS.

SUBSIDIARY leads or branch leads are taken from larger sized mains of constant E.M.F., or from terminals of generators with constant E.M.F. to supply current to one or more lamps, motors or other appliances requiring a constant E.M.F.

There is a drop of potential in the leads to be provided for so that the appliances may have to work at a reduced E.M.F. The E.M.F. of the leads is known, and the required E.M.F. of the appliance to be supplied with current, also its resistance, and a rule is required to calculate the size of wire in the lead to secure proper results.

The resistance of the leads supplying any lamp or appliance for a desired drop within the leads is equal to the reciprocal of the current of the lamp or appliance multiplied by the desired drop in potential expressed as volts. This principle is based on the fact that the drop in potential in portions of circuits varies with the resistance.

Example 10: A 110-volt lamp having a resistance of 220 ohms is to be placed 50 feet distant from a main having a constant E.M.F. of 115 volts. What must be the resistance of the line to maintain a constant E.M.F. of 110 volts at the lamp?

The lamp current is found by the formula:

$$C = \frac{E}{R} = \frac{110}{220} = .5, \text{ or } \tfrac{1}{2} \text{ ampere.}$$

The reciprocal of the current then is $\frac{2}{1}$. This multiplied by desired drop 5 volts $= \frac{2}{1} \times 5 = 10$ ohms, required resistance of leads.

For two or more lamps in parallel similar rules are applied.

In this case the E.M.F. of the terminals or main leads, the factors of the lamps, and their distance from the point of connection with the main leads require, to be given.

Example 11: A pair of subsidiary leads are to be run a distance of 150 feet from main leads, and to carry current for ten 50-volt lamps having a resistance of 100 ohms. The main leads have a constant E.M.F. of 55 volts. What is the resistance required in subsidiary leads, and what size of wire B & S gauge?

The combined R of lamps is found by formula:

$$R = \frac{R}{N}$$

Then $\frac{100}{10} = 10$ ohms, combined resistance of 10 – 100 ohm lamps in parallel, $\frac{50}{10} = 5$ amperes current to be supplied to lamps. The reciprocal of $5 = \frac{1}{5} \times 5 = 1$ ohm resistance required by line. Length of lead 150 ft. x 2 = 300 ft., total length of line. Required resistance 1 ohm ÷ 300 = .0033 ohms per foot, equivalent to No. 14 gauge wire as per table.

Or this may be worked out on the principle that the resistance of the leads is equivalent to the combined resistance of the lamps multiplied by the percentage of drop and divided by 100 minus the percentage of drop; which we can express in formula thus, using x as representing the required quantity:

$$x = \frac{R \times \%}{100 - \%}$$

The percentage of drop is found by dividing required drop in E.M.F. by initial E.M.F. on mains, and $\frac{5}{55} = 9\%$. The required resistance of the leads then is $\frac{100}{10}$ = combined R of lamps.

$$\frac{10 \times 9}{100 - 9} = \frac{90}{90} = 1 \text{ ohm, required R of leads.}$$

STRENGTH OF BOILERS.

The Steamboat Inspection Act, 1882, ss. 4, provides "that the areas of diagonal stays are found in the following manner:"

Find the area of a direct stay needed to support the surface, multiply this area by the length of the diagonal stay, and divide the product by the length of a line drawn at right angles to the surface supported to the end of the diagonal stay; the quotient will be the area of the diagonal stay required.

Example: Find the area required in a diagonal stay supporting 1 square foot of surface, boiler pressure being 75 pounds per square inch, length of diagonal stay 12 feet and length of line 9 feet, stress allowable per square inch of section on direct stay being 6,000 pounds.

$$\begin{array}{rl} 12 & \\ 12 & \\ \hline 144 & \text{square inches surface supported.} \\ 75 & \\ \hline 720 & \\ 1008 & \\ \hline 10800 & \text{total stress on direct stay.} \end{array}$$

10,800 ÷ 6,000 = 1.71 square inches, required area of direct stay.

$$\begin{array}{rl} 1.71 & \text{area of direct stay.} \\ 12 & \text{length of diagonal stay.} \\ \hline \end{array}$$

20.52 = 20.52 ÷ 9 length of line = 2.27 square inches, required area of diagonal stay.

When the tops of combustion boxes or other parts of a boiler are supported by solid rectangular girders, the following formula may be used for the purpose of finding the working pressure to be allowed on the girders, assuming that they are not subjected to a temperature greater than that of the steam and are supported by hanging stays.

Formula:

$$\frac{C \times d^2 \times T}{(W - P)\, D \times L} = \text{working pressure.}$$

Where W = width of combustion box in inches,
P = pitch of supporting bolts in inches,
D = distance between the girders from centre to centre in inches,
L = length of girder in feet,
d = depth of girder in inches,
T = thickness of girder in inches,
C = 500 when girder is fitted with one supporting bolt,
C = 750 when fitted with two or three,
C = 850 when fitted with four.

The working pressure for the supporting bolts and plate between them is determined by rules for ordinary stays already referred to.

The pressure allowed on plates forming flat surfaces is found by the following formula:

$$\frac{C \times (T + 1)^2}{S - 6} = \text{working pressure per square inch.}$$

Where T = thickness of plate in sixteenths of an inch,
S = surface supported in square inches,
C = 100; but when the plates are exposed to the impact of heat or flame, and steam only is in contact with the plates on the opposite side, C must be reduced to 50.

Example: Find safe working pressure of a flat-bottomed boiler whose stays are pitched 15 inches apart and thickness of plate is $\frac{1}{2}$ inch.

$\frac{C+(T+1)^2}{S-6} = \frac{100 \times (8+1^2)}{225-6} = \frac{8100}{219} = 37$ lbs. safe working pressure.

To find required thickness of plate we must reconstruct the formula :

$$\frac{S-6 \times P}{C} = (T+1)^2 \text{ and } \sqrt{T+1} = T.$$

Example : Find the required thickness of plate for a flat-bottomed boiler, whose stays are pitched 12 inches apart and steam pressure is 50 pounds per square inch, and depth of water in boiler is 7 feet. Also, what must be the diameter of stays if they are not allowed to carry more than 6,000 pounds per square inch of section ?

Pressure due to water = .433 x 7 = 3.031 lbs.
Pressure due to steam = 50.
Total pressure per square inch = 53. lbs.

Then

$$\frac{S-6 \times P}{C} = \frac{(144-6) \times 53}{100} = \frac{7314}{100} = 73.14.$$

And $\sqrt{73.14} = 8.55$. $8.55 - 1 = 7.55$ or $\frac{15}{32}$, required thickness of plate in sixteenths or thirty-seconds of an inch.

Stays are pitched 12 inches apart, and therefore must support a surface of 12 x 12 = 144 square inches.

144 x 53 = 7,632, total weight each stay is called upon to support.

7632 ÷ 6000 stress allowed per square inch of section of stay = 1.272 square inches, required area of stay.

$\sqrt{1.272 \div .7854} = 1.25$ (nearly), required diameter of stay.

It sometimes occurs that the stays of a boiler are to be fixed with cottars, and it is necessary to know what size the end of the stay must be swelled to so as to have the same strength as the stay. For this purpose the following formula is used :

$$D = \left(1 + \frac{.08}{N} + \frac{.4}{\sqrt{N}}\right)d$$

Where d = diameter of stay in inches.
D = increased diameter.
N = depth of cottar in terms of its width ; that is, if cottar is ½ an inch wide and 1½ inches deep, N would be 3, since depth of cottar is 3 times the width.

Example : The stays of a boiler are to be fixed with cottars ½ an inch thick and 2 inches thick, the diameter of stay being 1½ inches, what size must the end be made so as to have uniform strength with stay ?

$D = \left(1 + \frac{.08}{4} + \frac{.4}{\sqrt{4}}\right) \times 1.5 = (1 + .02 + .2) \times 1.5 = 1.83$ required diameter of end of stay.

SPARKS.

The Guelph Light & Power Company have just installed a new dynamo.

M. S. Cornell, of Stanbridge East, Que., will probably install an electric light plant next spring.

The Cardinal, Ont., Electric Light Company has been incorporated, with a capital of $20,000.

The Deseronto car works have turned out an electric snow plough and freight motor for the Kingston Street Railway Company.

Rev. D. B. Marsh, of Black Heath, Ont., inventor of the Marsh stethophone, is taking out patents in the United States and European countries.

The proposal submitted to the ratepayers of the town of Annapolis, N. S., to raise the sum of $12,000 to install an electric light plant, was recently voted down.

The works of the Toronto Electrical Works Company, Adelaide street west, Toronto, were recently damaged by fire to the extent of $10,000, the loss being partially covered by insurance.

The General Electric Company, of Schenectady, N. Y., have just received an order for 32 electric locomotives for the Central London underground railway, at London, England.

The city clerk of Chatham, Ont., is open to receive applications until the 15th instant for the position of city engineer, to take charge of the public works, electric light plant and city water works.

The town council of Napanee, Ont., have accepted a proposition made by John R. Scott to supply electric light. Mr. Scott agrees to install an incandescent and arc light plant within one year.

The Central Electric Light Company, of Portage La Prairie, Man., have elected officers for the ensuing year as follows :— President, Thos. W. Taylor, of Winnipeg ; vice-president, T. B. Millar ; secretary and manager, M. Blake ; other directors, Judge Ryan, Hon. Robt. Watson, and Wilson Bell. The reports presented showed a prosperous year's business.

The expenses of the municipal electric light plant at Lachine, Que., amounted in 1897 to $3,282, for a service of 850 incandescent lights and 43 arc lights. The receipts for the same year amounted to $3,066.

A meeting of the shareholders of the New Glasgow Electric Company, New Glasgow, N, S., was held recently for the purpose of authorizing the company to issue bonds for the sum of $35,000, with which to wipe out its present indebtedness.

On February 1st fire was discovered in the premises of Ness, McLaren & Bate, manufacturers of telephones and electrical supplies, Montreal. The stock and machinery on the third and fourth floors were almost totally destroyed, the loss being about $15,000.

The Dechenes Electric Light Company, of Dechenes Mills, Que., are having plans prepared for the construction of dams at Dechenes Rapids, intended to furnish 3,000 horse power. A new power house will also be erected, the contract for which will be let at an early date.

The charge of boodling brought against an alderman of Chatham, Ont., in connection with the installation of an electric light plant, has been dismissed without argument by Judge Housten. It is said that proceedings will now be taken against the persons instigating the prosecution.

The largest contract for electric lighting ever gived in London, Ont., was recently let by Messrs. McGaw & Winnett to the London Electric Company. The contract calls for the lighting of the Tecumseth House throughout, for which purpose between 600 and 700 lights will be required.

A new proposition for the supply of electric power to the city of Toronto has been made by the Georgian Bay Ship Canal and Power Aqueduct Company. The price quoted is six mills per electric horse power per hour, the company agreeing to supply 2,000 horse power within two years from the date of contract.

A live question now before the City Council of Ottawa, Ont., is whether the Deschenes Electric Light Company will be permitted to compete for electric lighting in that city, in opposition to the Ottawa Electric Company. Before deciding the question the aldermen are taking steps to secure as much information on the subject as possible.

Mayor Ovens, of New Westminister, B. C., referred in his inaugural address to the rapid growth of the electric light business, and pointed out the necessity of increasing the existing electric light plant, which is owned by the city. Two propositions are submitted, one to increase the present plant, and another to utilize some convenient water power and carry the current to the city by cable. The latter plan is recommended.

By a recent decision of the Supreme Court of Nova Scotia the act by which the Sabbath Observance Society sought to stop the operation of street cars in Halifax on Sunday was declared to be ultra vires of the Provincial Legislature. The Sabbath Observance Society had officers of the Halifax Electric Tramway Company summoned to the Police Court for employing men to perform labor on Sunday. The company asked the Supreme Court for a writ prohibiting the Police Magistrate from going on with the case on the ground that the act was ultra vires.

The city of Winnipeg, Man., recently invited tenders for electric street lighting for a period of years, also for furnishing an electric light plant. In response the following tenders were submitted : Goldie & McCulloch Co., Galt, steam plant, $10,310 ; Western Electric Company, Chicago, $20,850, $21,950 and $21,800 ; Robb Engineering Company, Amherst, N. S., $19,330, $20,480 and $21,200 ; McDonald Bros., Winnipeg, poles, wiring, etc., $22,500, steam plant, $9,068 ; Manitoba Electric Light and Gas Company, Winnipeg, from 47c. to 45c. per light per night for 121 lights for one year, for a period of from two to five years and for 200 lights, 39c. per light per night ; Northwest Electric Light Company, Winnipeg, 121 to 200 lights, 40c. per light per night ; W. A. Johnson Electric Company, Toronto, 200 lights, $19,265, including everything for supplying 250 lights $33,366 ; Fort Wayne Electric Corporation, Fort Wayne, Ind., electric plant, $9,285 ; Royal Electric Company, Montreal, electric plant, $10-000 ; installing and bricking in, $9,500 extra (this company submitted a supplemental tender of $12,050) ; Canadian General Electric Company, Toronto, electric plant, $13,540. No award has as yet been made, and it is probable that an electrical expert will be engaged to report on the tenders submitted.

ELECTRIC RAILWAY DEPARTMENT.

ANNUAL MEETING OF TORONTO STREET RAILWAY COMPANY.

The annual meeting of the Toronto Railway Company was held on January 19th last. The report presented stated that the net profits of the year 1897 were $332,022. From the profits two dividends, at the rate of 1¾ per cent. each, had been declared, amounting to $210,000, leaving, after the deduction of pavement charges, the sum of $62,022.50 to be carried forward. The gross earnings for the year showed a most satisfactory increase over the corresponding period of 1896. Apart from the increase due to the operation of the company's system on Sundays since 23rd May, receipts show steadily augmenting increases, and the directors have every reason to trust that same will continue throughout the present year. The average earnings on Sunday since that date were $1,277, which, on the whole was considered satisfactory, having in view the limited nature of the service.

The policy of keeping the plant in a high state of efficiency was maintained. The increased business having called for additional rolling stock, ten closed and twenty open motor cars were built in the company's shops, 31 iron trucks and 50 standard electric motors were added to the equipment, and in anticipation of further increased business the company have under consideration the building of additional cars for the current year. The appointment of Mr. E. H. Keating as manager of the company, to succeed Mr. Wanklyn, was sanctioned. The financial statement showed gross earnings of $1,077,612 and operating expenses of $525,801, leaving the net earnings for 1897 $551,811. There were carried 25,271,314 passengers, and 8,169,022 transfers were granted. The total assets of the company are valued at $9,957,159.

The board of directors was elected as follows: William Mackenzie, James Ross, F. L. Wanklyn, W. D. Matthews, James Gunn, C. E. L. Porteous, G. A Cox. At a subsequent meeting of the directors Wm. Mackenzie was elected president and James Ross vice-president.

THE QUEBEC DISTRICT RAILWAY.

During the year 1897 the citizens of Quebec and vicinity were afforded the means of quick transportation, the Quebec District Railway Company having put into operation some twenty miles of electric road. The old horse car system was taken over and electrified, and other extensions made wherever the traffic would seem to warrant. The power for operating the road is supplied by the Montmorency Electric Power Company, from their magnificent station at Montmorency Falls, a description of which has already appeared in the Electrical News.

The whole equipment of the road, with the exception of the rails, was furnished by Messrs. Ahearn & Soper, of Ottawa. The rolling stock consists of 30 vestibule cars, upholstered in best Wilton, cherry finish, mounted on Taylor trucks, each car equipped with two 12-A 30 h. p. Westinghouse motors, with multiple series controllers. Each car is lighted with fourteen lamps, and heated by Ahearn & Soper electric heaters, which are placed beneath the seats and are invisible. The cars are exact duplicates of those in use on the Ottawa system, including the same method of collecting fares and registering. There are five electric snow sweepers, each sweeper equipped with three 12-A 30 h. p. Westinghouse motors.

The overhead construction includes iron poles throughout. The trolley wire is No. 00 and the feeders are 500,000 circular mils. The rails are of the T pattern, 72 lbs. per yard in weight, and the whole track construction is of most substantial character.

Owing to the narrow streets in Quebec a great deal of the road is single track, thus necessitating a large amount of bracket work. The brackets were specially designed by Ahearn & Soper, and are of the most practical and substantial character. It is stated that the Quebec road is operated at 30 per cent. of its gross receipts.

The manager and chief engineer, under whose direct supervision the road has been constructed, and to whom the success of its operation is due, is Edward A. Evans, C. E. The officers of the company are as follows: President, Andrew Thomson; vice-president, E. W. Methot; secretary treasurer, J. R. H. White.

The steepest grade at present in use at Quebec is on Crown street, and is 15¼ per cent. Heavily loaded cars ascend this grade without difficulty.

BRITISH COLUMBIA ELECTRIC RAILWAY COMPANY.

The British Columbia Electric Railway Company, which is composed of British capitalists, issued a circular to the shareholders recently, in which the secretary says:

My directors desire me to convey to you the working results of this company for the first half-year of its existence. The directors particularly wish to draw your attention to the fact that the period under review is two weeks less than the full six months, the properties having been taken over on April 15th, and the books made up to September 30th. For that period the results were as follows:

	Gross Earnings.	Working. Expenses.	Net Profits in British Columbia
April (15 days)	$10,992.55	$ 7,900.58	$3,091.97
May	21,604.54	15,741.31	5,863.23
June	23,305.24	16,443.28	6,861.96
July	23,435.74	16,361.44	7,074.30
August	26,739.61	17,730.20	9,009.41
September	24,665.91	17,336.17	7,329.74
	$130,743.59	$91,512.98	$39,230.61 = £8,072

Deducting expenditures in London, Eng., the surplus for the complete six months is given as £2,300.

This satisfactory result is due to steady improvement in business, fairly evenly distributed amongst all the branches, and little benefit, if any, has as yet been derived from the various improvements which are at present being carried out with the capital derived from the issue of the income bonds. Of the improvements, to carry out which the issue of income bonds was made, the extension to Stanley Park, and the improvements on the Westminster branch have been satisfactorily completed, and the economy of £3,500 per annum expected from them should shortly commence to show in the returns. The installation of water-power at Victoria is in course of construction, and, the board anticipate, will be finished about March 31st. Before finally making this important expenditure of capital, the board decided to call in still further expert advice, and secured the services of Mr. J. M. Campbell, of Toronto, electrical engineer of very high standing, and of long experience in this class of business. The board is glad to state that Mr. Campbell not only confirmed the opinion of the previous expert, but put the increased annual profits to be derived by substitution of water power for steam power, and the other improvements in Victoria now in hand, at £9,000 per annum. The installation of water power at Vancouver has been deferred for the present.

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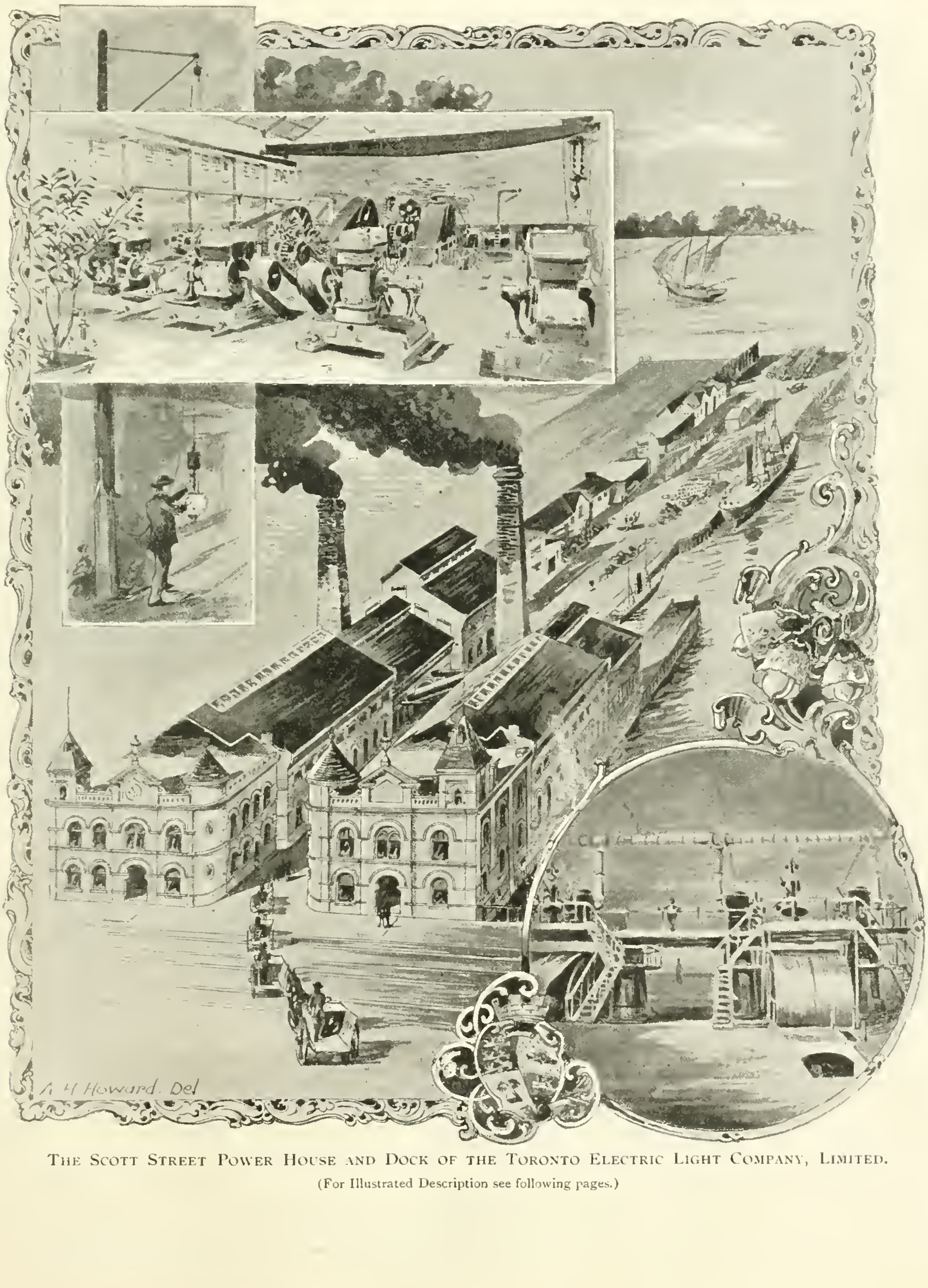


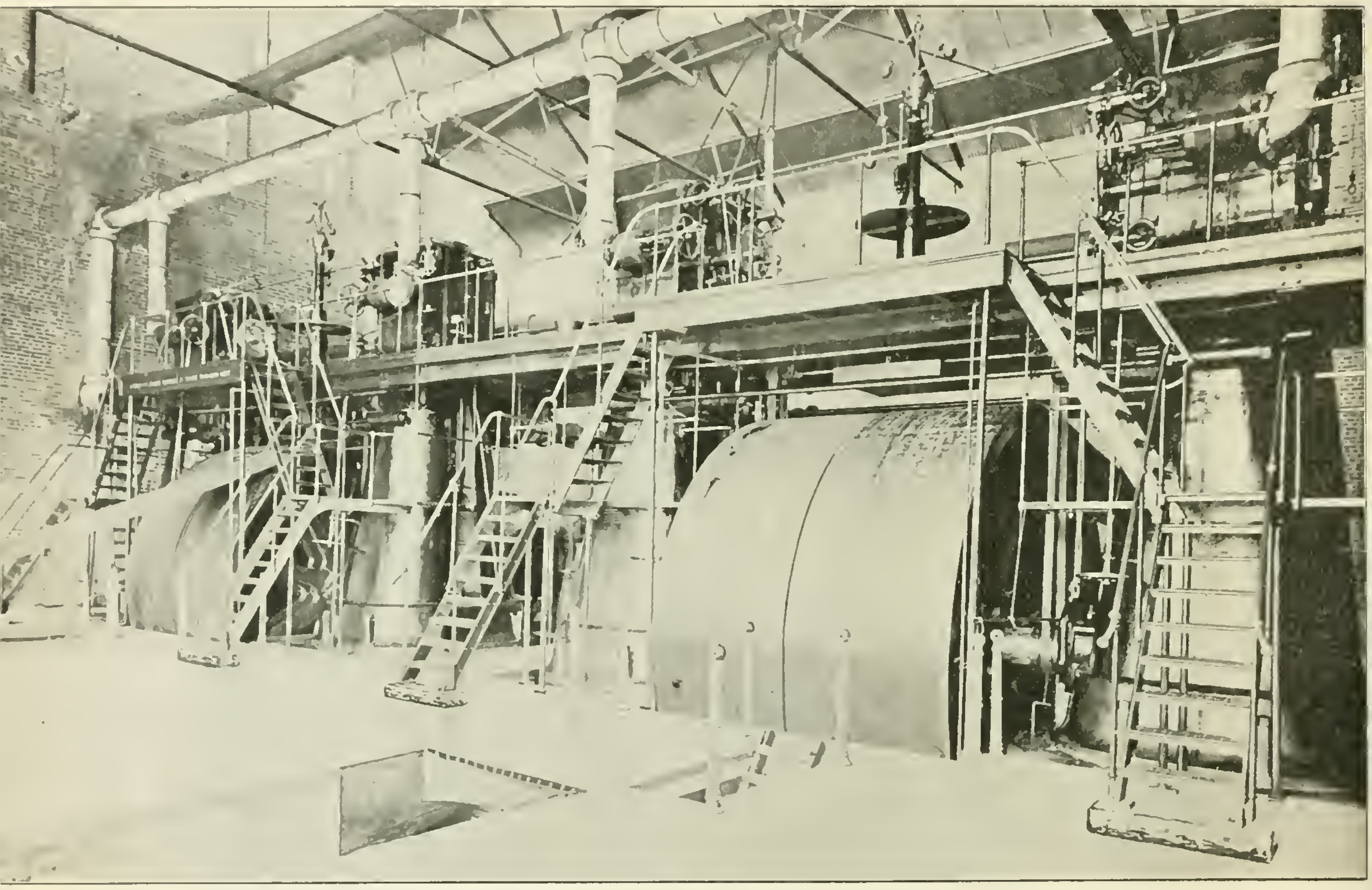
THE SCOTT STREET POWER HOUSE AND DOCK OF THE TORONTO ELECTRIC LIGHT COMPANY, LIMITED.

(For Illustrated Description see following pages.)

THE NEW WORKS OF THE TORONTO ELECTRIC LIGHT COMPANY.

On the 21st day of January, 1897, the arc light station of the Toronto Electric Light Company was totally destroyed by fire. The building was of frame covered by corrugated iron, and had served the needs of the company in the early stages of its career. The continual increase in the number of dynamos and engines had necessitated the building of platforms to carry the dynamos above the shafting, and finally the building became very much crowded. Although there was considerable timber in the structure it was thought that owing to the continuous presence of the employees the risk was not great. Events proved differently, however. So sudden was the outbreak that all the engines could not be stopped, and the men had to make a hurried exit by the windows, leaving even their personal effects behind. Owing to rapid temporary work the lighting of the city was very little interfered with, and work was at once commenced to clear the ground for a new structure. Steam derricks were erected, and the dismantled dynamos, shafting and engines lifted out and cleared away. While the ground was being cleared plans were got out for new structures, and it was determined that, whatever might be the next cause of trouble, it would not be fire. There is absolutely no wood or any combustible substance used in any part of the construction. We are enabled to present our readers with a general view of the reconstructed works and some of the details of the various buildings. The arc light station No. 1 is shown by photographs taken of each end from the center of the building. At one end will be seen the arc light switchboard, which is built of pressed brick with terra-cotta trimmings, and is surmounted by a clock driven by electricity, which is one of a number distributed around the works, and forming part of the general time system that is being introduced into various parts of the city. Each arc circuit has ampere meters on the face of the switchboard large enough to be seen from any part of the room, and behind the wall there is a slate shelf for standard ammeter, which can be plugged into any circuit desired, and also polarity indicators to ensure the currents flowing in the proper direction.

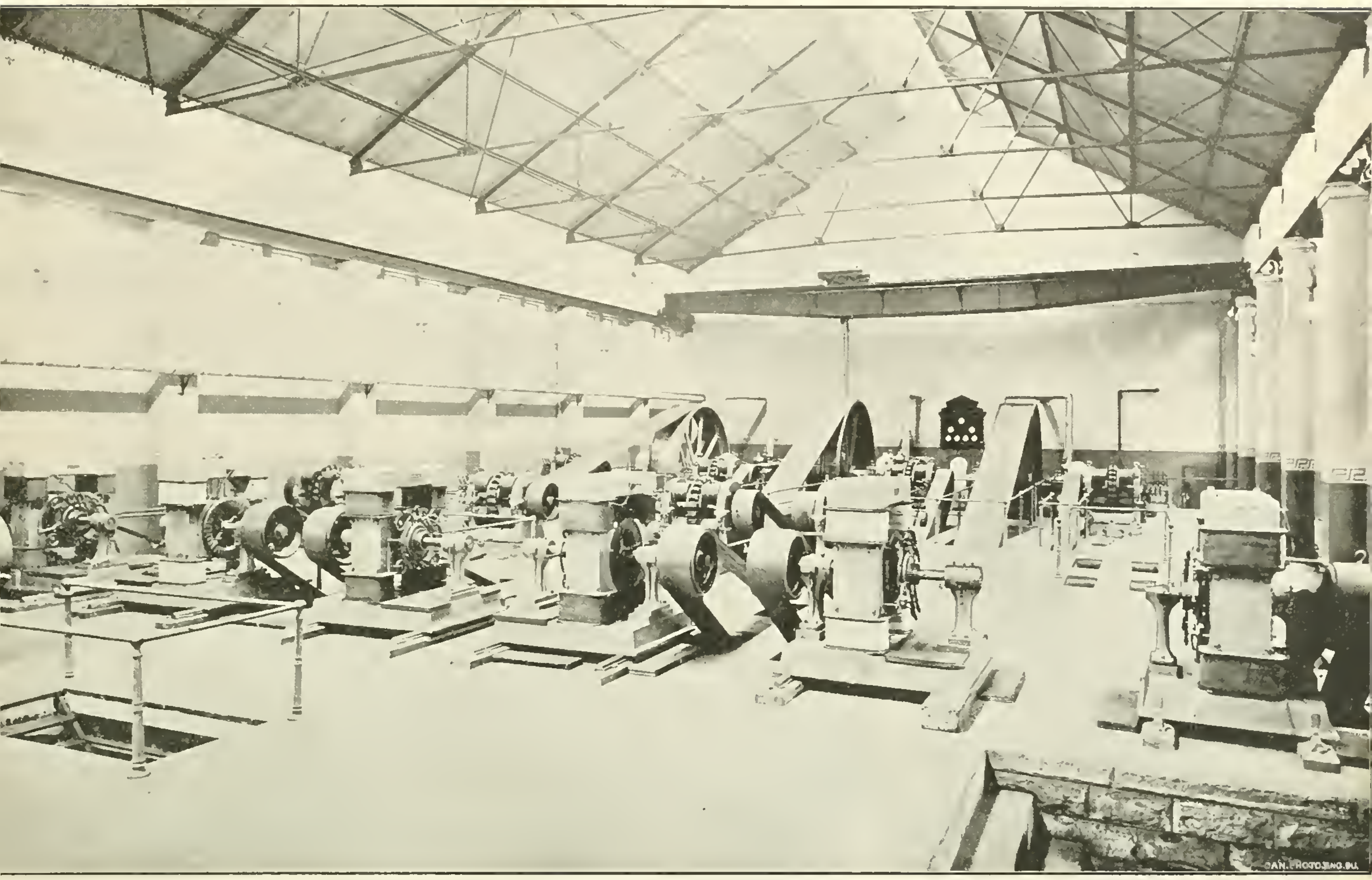
When the ground was cleared the first thing done was to drive piles for the foundations to the solid rock. Such piles as were under the old building were utilized, and new ones driven where necessary. The piles were cut off level at the lowest water line, and on them was laid a solid bed of concrete over the entire space, 2 feet 9 inches in thickness. Upon this the dynamo foundations were built, and were carried up to a height sufficient for headroom under the arches which connected them together. This formed tunnels for the shafting, the pedestals for which were anchored to the concrete bed. Intermediate arches, wherever necessary to continue the floor between dynamo foundations, are carried on heavy I beams on cast iron pillars. Stairs to these tunnels, doors, window frames, roof beams, railings, etc., are all of iron. There is also a twenty ton travelling crane which can be used over any part of the floor. This has been of great advantage in handling the machinery during installation, and will no doubt effect a considerable saving in time in the event of the machinery being handled for repairs. The shafting is all extremely heavy and runs in self-oiling bearings of the best design. There appears to be nothing omitted that experience has shown to be advantageous in the operation of an electric light installation.



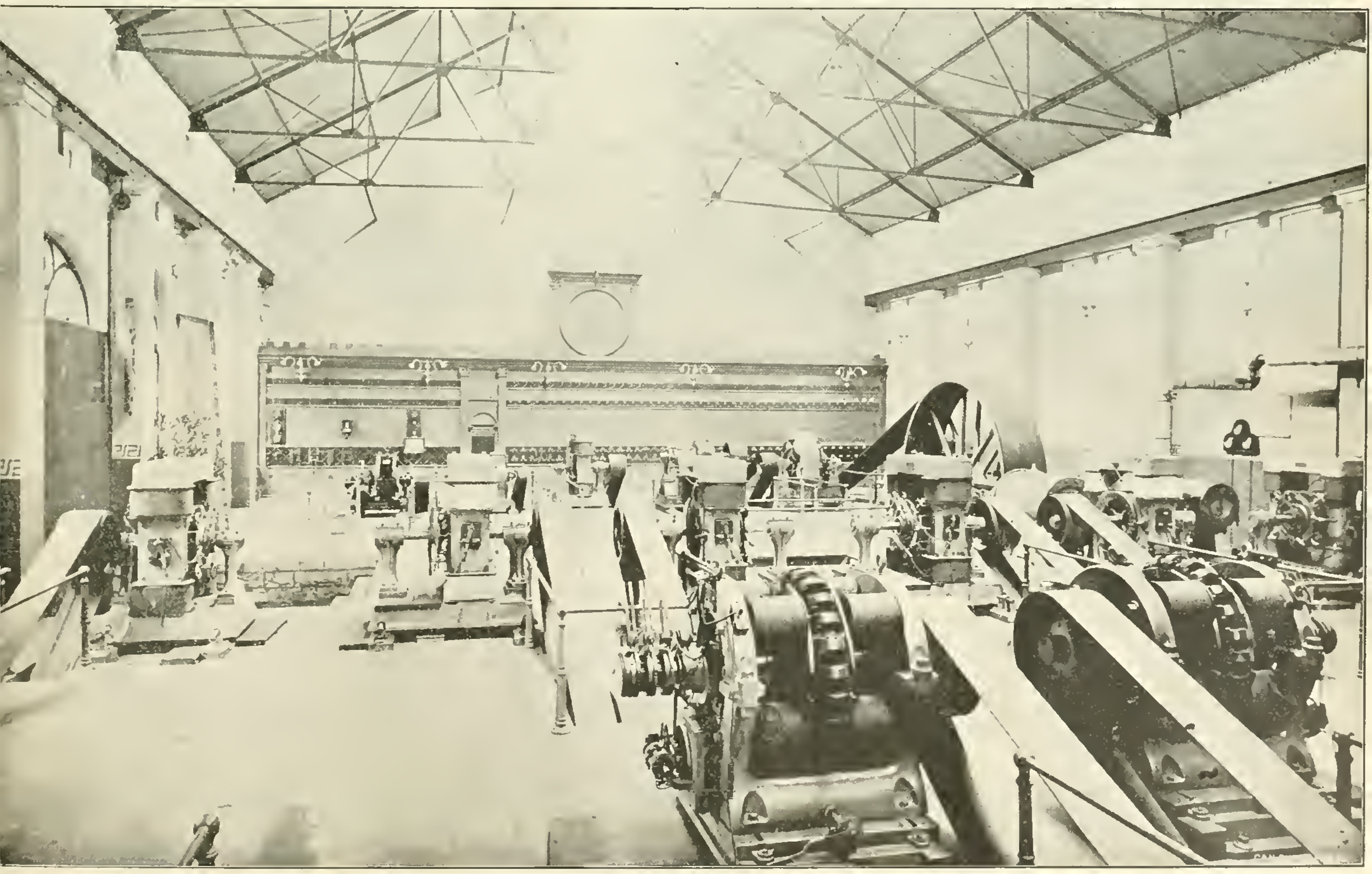
3,000 H.P. Engines in No. 3 Station, Toronto Electric Light Co.

The building in front and to the east of the general offices of the company is now being finished, and will be utilized as store rooms for all supplies, show rooms for incandescent fixtures, and meter department. This building is erected entirely of brick and iron, with concrete floors and terra cotta partitions. It also contains accommodation for nightwatchman and for lineman on duty at night, with horse and quick hitching attachment for sudden calls. This saves time that would be necessary to get a horse and rig from the general stables, which are situated at the rear end of the lot.

Station No. 3 is also a brick and iron building of a similar character to the arc light station, and is equipped with two pairs of upright Corliss engines of 1000 to



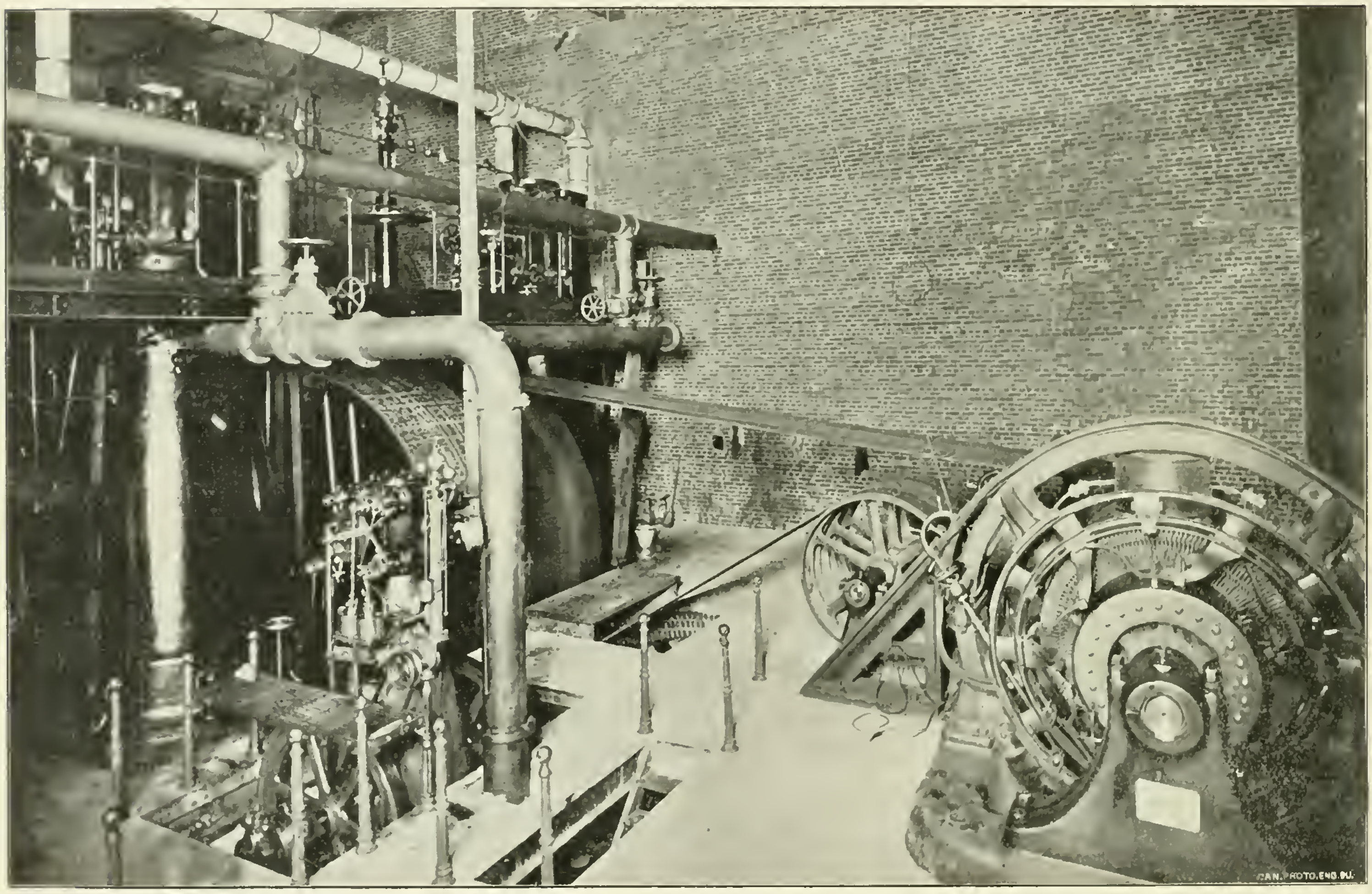
ENGINE END OF NO. 1 ARC LIGHT STATION, TORONTO ELECTRIC LIGHT CO.



SWITCHBOARD END OF NO. 1 ARC LIGHTING STATION, TORONTO ELECTRIC LIGHT CO.

1500 h. p. each. These engines are shown in our illustrations. There are four dynamos in this building—two of 500 k.w. capacity 250 volts for motive power purposes, and two alternators of 450 k.w. capacity each. One of the illustrations shows a direct current generator, but owing to the limited space available for the purposes of the photographer, it does not give a very clear idea of the surroundings. In this cut may be seen one of the automatic cut-off air pumps and condensers, which are used throughout the installation.

Station No. 2, or the most westerly of the lot, is a similar construction to the building that was destroyed, with the exception that it is lined inside as well as out with sheet iron, and the floor joists and uprights are also cased in sheet iron. It contains a double tandem upright Corliss engine of 1000 horse power capacity, and also the general distributing switchboard for all the output of current for power and incandescent light purposes. It is the intention to rebuild this as soon as the weather permits, and replace the present structure with a building of a similar class to the new ones. The foundations have already been built of stone and concrete, and it is expected that the building will be completed in the early summer. The engine will have a new fly wheel of 60 inches face, and the shafting will be rearranged and placed in brick tunnels, as in the new buildings, and the space that will be gained will be arranged for the installation of two direct connected units of 1000 h.p. each.



Direct Current Generator, 250 volts, 500 k.w., Toronto Electric Light Co.

The company have also decided to erect coal handling and storing machinery of the latest type, so that coal arriving by vessel can be unloaded and delivered in the boiler houses with the minimum of handling and expense.

The whole of the works above specified, including the rebuilding of one of the boiler houses, and the construction of the iron roof, have been done by the employees of the Toronto Electric Light Company, including the original designs and all the labor necessary in the carrying out of the various works—the only exception being the pile driving and the construction of the travelling crane, which were done by contract.

The detail of the foundation work, some of which was of a very difficult character, having to be laid under water, as well as the general arrangement of the buildings, are of a very interesting character and would well repay a visit by anyone interested in such matters. Visitors are always welcome and will be shown anything and everything in connection with the operation of this extensive plant.

A LETTER OF THANKS.

Montreal West, February 9th, 1898.

To the Editor of the Canadian Electrical News.

Sir,—Permit me to thank those of your readers who so kindly forwarded samples of boiler scale and feed water in connection with articles now in course of publication in the Electrical News.

Personally the results have been indeed gratifying. With the exception of P. E. Island, I have received samples from every province in the Dominion ; and what is more pleasing, samples have been received from steam users, engineers, and manufacturers of scale resolvents, as well as dealers in this line of goods.

This is also a gratifying evidence that the Electrical News is widely read, and that the subject is an interesting one to all classes of readers.

Unfortunately articles of this kind cannot be written in popular style. I shall in future, however, endeavor as much as possible to avoid the use of technical terms.

I cannot too highly express my thanks to those engineers with whom I entered into private correspondence for their very flattering appreciation of the work upon which I have been engaged.

Yours very truly,

Wm. Thompson.

The United States Consul Morris, of Ghent, Belgium, states that the most extensive product of the world is charcoal thread, which is employed for incandescent lamps, the article for the most part being manufactured at Paris, and coming from the hands of an artisan who, for the present remains unknown in order to better protect the secret of manufacture. It is by the gramme—15½ grains—that this product is sold at wholesale, and, in reducing its price to the basis of pounds, it is found that the filament for lamps of twenty candles is worth $8,000 per pound, and that for lamps of thirty candles is rated at $12,000 per pound ; the former have a diameter of 0.020 of a millimetre—one millimetre equals 0.0394 inch—and the latter of 0.0045 of a millimetre.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By. Wm. Thomson.

[Article 3].

Having discussed the presence of corrosive agents in solution, we now require to turn our attention to the presence of impurities likely to occur as dissolved solids and solids held in mechanical suspension, some of which are liable to form scale or encrustation.

The total solids contained within a boiler feed water may be in either of one of two conditions, in mechanical suspension, as small particles, or in chemical solution; and water may contain impurities as per following table:

In mechanical suspension:	Organic matter	Animal. Vegetable.
	Inorganic matter	As sand, mud, etc.
In solution:	Organic matter	Animal. Vegetable.
	Inorganic matter	Scale forming. Non scale forming.

Matter in mechanical suspension, whether organic or inorganic, may be removed by filtration, but matter in chemical solution, as dissolved impurities, cannot be removed by mere filtration, but must receive treatment either by chemicals or heat, the aim being to get a precipitation whereby we have the impurities in condition first named.

I shall not attempt to deal with the whole of the chemical compounds that may at times be found in natural waters, but confine myself to those compounds of common occurrence with which we are all well acquainted. These may be classed as the oxides, chlorides, carbonates, bi-carbonates and sulphates, being the compounds formed by the union of the various acid radicles with the basic radicles or metallic elements, those most commonly found being silicon, aluminum, iron, calcium, magnesium, sodium and potassium.

Before proceeding to discuss the nature of the scale formed or the action of these various compounds within the boiler, it is first necessary to briefly explain their presence in the water. One of the commonest and most important of these groups of salts, and a group with which we are most frequently called upon to deal, is the carbonates. They are very widely distributed, being found in considerable quantities nearly the world over. Carbonate of calcium is found in the well known forms of limestone, marble, chalk, coral deposits, etc. Carbonate of magnesium occurs quite frequently as magnesite and in combination with carbonate of calcium very largely as dolomite.

Carbonate of iron occurs less frequently, and not so largely diffused in nature, as sidenite or spathic iron.

The carbonates of the alkaline bases, sodium and potassium, occur very largely in the alkaline districts, but being soluble at all temperatures found in boiler practice, do not play such an important part in engineering practice as scale-forming agents as do the carbonates of the alkaline earths.

The whole of the carbonates are formed by the union of carbonic dioxide (Co_2) with some one of the metallic oxids, such as calcium oxid (CaO), magnesium oxid ($Mg O$), sodium oxid (Na_2O), etc.

The usual chemical reaction taking place may be classed as a double one, carbonic dioxide (Co_2) first combining with water ($H_2 O$) to form carbonic acid ($H_2 Co_3$). The metallic oxids just named enter into combination with carbonic acid as follows:

Calcium Oxid. Carbonic Acid. Calcium Carbonate. Water.

$$Ca O + H_2 Co_3 = Ca Co_3 + H_2 O.$$

and

Magnesium Oxid. Carbonic Acid. Magnesium Carbonate. Water.

$$Mg O + H_2 Co_3 = Mg Co_3 + H_2 O.$$

In this case the bi-valent basic radicles of calcium and magnesium replace the hydrogen of the carbonic acid and the liberated hydrogen enters into combination with the oxygen of the metallic oxid; consequently from the combination of two chemical compounds as shewn in equation two new compounds, consisting of either of carbonates of calcium or magnesium and water, are formed. The combination between the oxid of sodium and carbonic acid is practically the same with this exception: Sodium is a univalent metal, consequently has the power to replace only one atom of hydrogen, therefore one molecule of sodium oxide must always consist of two atoms of the metal sodium in combination with one atom of oxygen. The chemical reaction for the production of sodium carbonate therefore is:

Sodium Oxid. Carbonic Acid. Sodium Carbonate. Water.

$$Na_2 O + H_2 Co_3 = Na_2 Co_3 + H_2 O.$$

As a rule, out of all the scale-forming material found in feed waters, none occurs so frequent, nor yet in such large proportion, as does carbonate of calcium; next in order carbonate of magnesia may be said to occur. Carbonate of iron occurs in limited areas and never in large quantities.

The carbonates of calcium and magnesium are very slightly soluble in water, and very rarely exist as such in quantities exceeding two grains per imperial gallon, and it is very rare that they are present in the water separately, as they usually exist in water together, and in this case the total held in solution never exceeds the maximum quantity of either which the water is capable of dissolving. This small quantity of dissolved solids would have but little effect in a boiler feed water, and draws our attention to a very important fact. If the carbonates of calcium and magnesium are, as stated, nearly insoluble in water, how is it that they predominate as scale-forming impurities and are so often found in chemical solution in boiler feed waters in such large quantities?

If we turn back to the article on dissolved gases, we shall find that many gases are very soluble in water, and it is this fact that plays such an important part in explaining the presence of insoluble carbonates.

Wherever organic decomposition or combustion is taking place carbonic dioxide (CO_2) is being constantly evolved. This at ordinary pressures and temperatures exists as a gas, and is therefore a constant constituent of the atmosphere; it is also contained in the soil as a product of organic decay.

J. A. Wanklyn, in an excellent work on "Water Analysis," published in London, England, states that "in many natural waters there is more carbonic acid gas in some form or other than any other single foreign material." As already seen, carbonic dioxide is very soluble in water; some is absorbed by falling rain, and a still greater quantity as it passes through the soil. We have already noted the very wide distribution of the various carbonates in nature, and although the carbonates of lime and magnesia are nearly insoluble in water, they are very soluble in water containing carbonic acid.

The carbonates of lime and magnesia appropriate a portion of the carbonic acid equal in quantity to that already existing in combination with their oxids to form the carbonate, thus forming what is known in chemistry as a bicarbonate, according to the following equation:

Carbonate of Lime. Carbonic Acid. Bicarbonate of Lime.

$$Ca Co_3 + H_2 Co_3 = Ca H_2 (Co_3)_2.$$

and

Carbonate of Magnesia. Carbonic Acid. Bicarbonate of Magnesia.

$$Mg Co_3 + H_2 Co_3 = Mg H_2 (Co_3)_2.$$

Both the bicarbonates of lime and magnesia are very soluble in water, and the presence of carbonate of lime and magnesia in boiler deposits may then be explained as follows: The rain reaches the earth charged with a certain quantity of carbonic acid, and in passing through the soil takes up a still greater supply, and after passing through the earth rarely escapes contact with some of the carbonate rocks, which dissolve in it. After passing over these rocks and forming new solutions, the water again reaches the surface and forms the supply of our rivers, lakes or wells, from which we take our boiler feed supplies. These bicarbonates are very unstable salts, and are much more soluble in cold water than hot, owing to the fact that a rise in temperature drives off the excess of carbonic acid and the bicarbonate is as a consequence reduced to the carbonate, in which condition it is nearly insoluble. When a temperature of 180° F. is reached a large percentage of the carbonic acid is driven off, and the bicarbonate consequently suffers reduction to the carbonate, and at 290° F. the precipitation is complete. Thus we are readily enabled to account for the presence of the carbonate salts in boiler encrustation.

Next to the carbonates, the sulphates play an important part in feed waters. The sulphates of magnesium, sodium and potassium are all readily soluble in water, and although they play an important part in the treatment of boiler feed waters, need not be referred to here.

Probably no scale-forming salt has given more trouble or been more destructive to boilers than has sulphate of calcium. Sulphuric acids readily attack nearly the whole of the metallic oxids and especially those under consideration, forming sulphates and water, thus:

Calcium Oxide. Sulphuric Acid. Calcium Sulphate. Water.

$$Ca O + H_2 SO_4 = Ca SO_4 + H_2 O.$$

Calcium sulphate or sulphate of lime is found in nature widely distributed, occasionally in the anhydrous form as anhydrite, and much more commonly as the hydrate known as gypsum. When gypsum is heated to about 240° to 250 F., it loses a large proportion of its water of crystallization and becomes what is known to us as plaster of Paris. This product is, as we know, capable of taking up another portion of water and "setting" to a close, hard stony mass. The anhydrous sulphate is nearly insoluble in water, but the hydrated form dissolves fairly readily and up to about 120° F., as the temperature increases the solubility increases. Above 212 F. solubility decreases very rapidly, and at 300 F. it becomes almost entirely insoluble. Unlike the carbonates the presence of carbonic acid gas has no effect upon its solubility, its solubility being entirely due to the solvent power of the water itself. When the hydrated sulphate of lime precipitates it loses a portion of its water of crystallization, and when it reaches the boiler plate the balance, and it is consequently converted into the anhydrous state, and this change in crystalline form is largely the cause of precipitates containing sulphate of lime being bound into such hard compact masses and forming such a troublesome scale.

As already stated, sulphuric acid occasionally occurs in streams, etc. If bicarbonate of lime or magnesia are present free acid will not exist until the salts of calcium and magnesium have been reduced from carbonates to sulphates. The same reduction takes place when water containing sulphuric acid is passed over limestone rocks, and since rain water has been shown by numerous chemists to contain traces of sulphuric acid, the presence of sulphate of lime is largely accounted for. The chlorides of the various metals under consideration are frequently present in feed water, especially sodium chloride, which is simply common salt. Since, however, the whole of the metallic chlorides we have occasion to refer to are easily soluble in water and do not form scale except in extreme cases, we do not require to refer to them at any length, particularly since we shall require to discuss them fully at a later stage, chiefly as to their effect on the scale-forming agents.

The oxides of silicon and aluminum are frequently found in scale, and when present in any quantity form a very troublesome scale. They are not easily soluble in water, but often occur in large quantities where muddy water is used without previous filtration.

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AND
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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Legal Rights of Telephone Companies.

JUDGE Cox of the Supreme Court of the District of Columbia has lately given a decision of much interest to telephone companies and telephone subscribers. An hotel keeper at Washington was threatened with the removal of his telephone if he continued to permit the free use of the instrument to his patrons. He applied to the court for an injunction to restrain the telephone company from carrying out their threat. While granting the injunction Judge Cox imposed certain restrictions upon the plaintiff as to the use which might be made of the telephone. One is that while boarders in the hotel may telephone for a baggage waggon, they are not entitled to use the instrument to order theatre tickets or stock reports. These restrictions are based on the fact that the guest in the hotel does not get free cabs, telegrams, newspapers, or boot shines. Judge Cox very correctly points out that "When the subscriber allows others to use his telephone it is an abuse of the time of the telephone operator. It is also an infringement on the rights of the Bell Telephone Company, which receives a royalty from the defendant. Furthermore it is an infringement of the rights of other subscribers. It is very annoying for a subscriber to call for a certain number and be told that the connection he wants is busy, that being due to the fact that a non-subscriber is using free of charge, the telephone with which connection is desired"

Canadian Electrical Association.

THE Committee on Legislation of the Canadian Electrical Association thought it advisable, notwithstanding the shortness of the late session of the Ontario Legislature, to make an attempt to secure a measure of relief to gas and electric lighting companies, from unfair and unjust municipal competition. With that object in view a short bill was prepared which came before the Municipal Committee. After discussion those representing the Association consented to a suggestion of the chairman and other members of the committee, that the matter should stand over for a year. The committee thought that in view of the early adjournment of the House, and the pressure of business consequent upon an unusually brief session, there was not time to give the bill the proper amount of consideration. The discussion, however, brought out the fact that there could be found no solid objection to the principle of the Bill, while on the contrary the injustice of the present law was brought into clearer prominence. The necessity and propriety of some measure of relief which will prevent the confiscation of electric light investments may be considered now to be generally admitted, and there is reason to hope will be forthcoming at the next session of the legislature. The electric light companies throughout the province, who are all more or less interested, should give the Canadian Electrical Association their hearty support in this movement.

Electric Lighting for Profit.

AN able paper on this subject was recently read before the Northwestern Electrical Association by Mr. Alexander Dow. The text of the paper was that at the present time the policy of electric light managers should be to sell electric energy to every accessible user, at the lowest price which will realize a fair profit on the capital invested. It was argued that the few who are still following old methods and asking high prices for energy are simply advancing the cause of municipal control. Perhaps the most important subject touched upon by Mr. Dow in his paper was that of supplying light and power from the same units. He believes the best practice of to-day is to furnish arc and incandescent lights, as well as motive power, from the same dynamos and mains, thereby greatly reducing the cost of plant and distribution lines. While this is a subject which should be considered in the original design of a station, Mr. Dow points out that there are instances where old stations have been re-arranged, with very satisfactory results. Only for railway work does he advocate the installation of separate units, giving as his reason that there has not yet been devised a satisfactory system whereby a supply of 500-volt current can be combined with a general lighting distribution system. In the winter season the load on street railways coincides with the heaviest load on the lighting system for an hour or so each day. Mr. Dow concludes his paper with a plea for greater educational work among electric light men, municipal authorities and municipal theorists.

Acetylene Gas.

IN view of the effort that is being made, principally by the eight or nine companies engaged in the manufacture of acetylene gas machines, to introduce acetylene gas throughout this country, we publish in this number the rules which have been adopted by the insurance authorities of Germany and Canada for regulating its use. A careful perusal of these rules should be sufficient without further argument to show the extremely dangerous character of acetylene, and it is well that the dangers attendant upon its use should be understood at this stage, when as yet it has come into use in but few places. We are surprised to learn that in one or two towns an effort is being made to displace the electric light by acetylene gas. We cannot imagine that the effort will be successful, but should the citizens of these towns be induced by specious arguments, and the novelty of the new light, to adopt it in preference to the electric light, they will assuredly have cause to regret their action. A material that is not allowed to be kept within a building, even when gas machines of approved design are used, except at an additional cost for insurance of 10 cents per $100 per year, or 20 cents per $100 for a three years' risk, must indeed be dangerous in its character. Further than this the German regulations provide that persons engaged in handling the carbide should be free from heart and lung diseases and should wear a respirator and eye protectors. These two features of the regulations are sufficient to show the dangers attending its use. It is difficult to believe that a material which must be surrounded by so many safeguards will find extensive and permanent use. Certainly, no well conducted electric light concern need have any fear of successful competition from this source. We are not in a position to speak definitely with regard to the price at which acetylene can be supplied, but the fact that the Wilson Carbide Company at Merritton are contending in the courts for the privilege of operating their works on Sunday, on the ground that only by so doing can the business be conducted at a profit, and their statement that the operation of the works thus far has resulted in a deficit of some $7,000, would seem to show that the cost of production is so great as to allow but a small margin of profit.

Efficiency of Motors.

COMPETITION in the manufacture of motors has been the result of some concerns turning out cheap work and of course inferior articles. It is very seldom the purchaser of a motor ever asks the efficiency, he being content to get a certain size for the lowest possible price, and taking the rest for granted. The result of this is disastrous to the company supplying the power—and instances of this kind are very numerous—the supply company getting the name of being extortionate in its charges, whereas the trouble is originally with the motor. We have heard of smaller size motors (from 15 h.p. down) taking as high as 4 e.h.p. for 1 B.H.P. This is certainly not as it should be, and shows room for improvement. Purchasers will pay a higher figure for motors when the efficiency is higher, and they will find that it pays ultimately when they are paying for their power by meter measurement. If, however, they are by "contract" and the contract is based, as is usually done, on the amount of machinery to be driven, it is only natural to expect a "boost" at the expiration of the contract if a meter has been put on as a check, which is done in all well-regulated plants. The customer would never think of the motor being the cause of the trouble, but he certainly thinks and does not hesitate to say the company is robbing him, whereas as a matter of fact he is robbing himself, for he is getting an E.H.P. for say 2 cents per hour and paying about 6 to 7½ cents per B.H.P. Let manufacturers settle down to making first-class apparatus giving the highest possible efficiency and they will find purchasers. If there were not any poor machines made none would be bought, and we are certain that the manufacturers themselves are largely to blame for this state of affairs.

Economy of Water Power.

WATER power is always assumed to be more economical than any other source of energy, since it is supplied naturally gratis. We think, however, there is considerable room for discussion on this point. The cost of installation, together with the purchasing of water and pole line rights, brings fixed charges up to such a point as to make it very doubtful, indeed, whether power delivered from a water-driven plant for considerable distances can be done at a less cost than that produced locally by steam. Where water power is limited and a reserve steam plant has to be kept, the advantage is still more doubtful. Changing plants from steam-driven to electrically driven from some distant water power, should receive the most careful consideration, as no doubt is usually the case. Difficulties, such as breaking down of pole line, generators and turbines being disabled, etc., all tend of course to increase the risk. Certainly the chances of a shut-down are greater in the case of a distant plant — a most important consideration. Where there is a large load the cost per light per year may be reduced to such a figure as to render it an impossibility for water power to enter into the system if it has to be delivered from a considerable distance. This, however, can only be done by first-class apparatus, such as boilers, engines and generators. First cost, we regret to say, enters more into consideration with purchasers than it should do. This should be secondary, efficiency being the main point at issue. If a boiler maker supplies a boiler and guarantees an efficiency of 85% and fulfils same, it is surely worth a great deal more than one which will give only 60%. In how many cases does the efficiency of the boiler enter into consideration? This is a question worth pondering over. If an engine builder guarantees a 500 h.p. engine to run on 13 lbs. steam per h.p. hour, and fulfils his guarantee, this engine is a far better investment than one taking 26 to 30 lbs. and costing only one-half of the other. We believe there is an utter lack of attention on this point, and the sooner a thorough system of testing boilers and engines in steam and electrical plants is inaugurated the better. When this is done and old boilers and poor engines discarded, the question of substituting water power for steam is never likely to be a very serious one with local plants, especially when the water power is at some considerable distance and the power is generated in large quantities by the local plant.

SAFEGUARDS AGAINST ACETYLENE GAS.

THE dangers attending the manufacture, compression and liquefaction of acetylene gas are provided against in Germany in a series of rules issued by the Imperial Insurance Office, of which the following is a condensation:

RULES FOR EMPLOYERS AND FOREMEN.—Liquefaction of acetylene must be carried out apart from the manufacture and compression; but if the gas is compressed to eight or more atmospheres, the compression also must take place in a separate apartment. The apartments must be well lighted and ventilated, have doors opening outwards, and be heated only by steam or hot water. External sources of light only may be used; or, in urgent cases, safety lamps may be resorted to. The carbide must be kept in moisture-proof vessels, which vessels must be stored in well-ventilated dry apartments (not cellars). The vessels should be opened only as needed for immediate use. As little dust as possible should be made in breaking up the carbide; and persons engaged in the work should be free from heart or lung diseases, and should wear a respirator and eye protectors. The gas holder must be situated in an open, or in a well ventilated apartment away from the generating room, and it must be provided with a pressure gauge. An efficient washer must be placed between the generator and the holder. The gas must be generated by the gradual addition of carbide to a large excess of water, and not by adding water to carbide. Compression of acetylene to more than ten atmospheres pressure must only be carried out in strongly cooled apparatus. In the liquefaction of acetylene, the condensing vessel must be emptied at the close of operations, and the cylinders used for the conveyance of liquefied acetylene must have been tested to 250 atmospheres pressure, and have their contents signified on the outside—in white. Before and after filling, the cylinders must be weighed with precision, and no more than 1 kilo, of acetylene per three liters capacity (20.8 lbs. per cubic foot) be admitted. The charged cylinders must not be exposed to heat. The cylinders and all apparatus which comes in contact with liquefied acetylene must be entirely free from copper, and sharp angles in valves and apparatus avoided.

RULES FOR WORKMEN.—Naked lights and lucifer matches must not be used in apartments of acetylene works and safety lamps must not be opened. In breaking lumps of carbide, as little dust as possible should be made. Water must never be added to carbide, and only small pieces of carbide added to water. The prescribed temperatures must be closely observed in the compression and liquefaction of the gas. The cylinders used for liquefied acetylene must answer to, and be filled in accordance with, the prescribed conditions. On opening a cylinder, take care the acetylene issues very gradually.

A copy of the rules must be hung in a suitable place in the apartment. Fines are imposed for breaches of regulations.

The following are the regulations governing the installation and use of acetylene gas, adopted by the Canadian Fire Underwriters' Association, November, 1897:

For each approved Standard machine installed and maintained in accordance with the following rules, in the building insured, or in any building connected therewith, an extra of 10 cents per $100 for annual risks, and 20 cents per $100 for three year risks must be paid on the building and its contents.

If the apparatus in the building insured, or in any building connected therewith, has not been approved by the association, or if it is not installed or maintained in accordance with said rules, double rates must be paid.

No charge to be made for an approved Standard machine when installed outside in a first class building (having no communication with the building insured), or in a building of any construction detached not less than 15 feet.

REGULATIONS.

1. No apparatus for generating acetylene gas shall be installed until that particular pattern of machine has been examined and approved by the association. Any manufacturer of such apparatus desiring to have the use thereof sanctioned by this association, must furnish the secretary with a copy of working drawings and specifications of materials used in making the machine, one of which he shall exhibit in full working order, and submit same to such tests as may be required by the inspector of the association. The expense of such inspection shall be paid by the manufacturer. If the apparatus is approved by this association, the manufacturer shall sign an agreement that all machines made and sold by him shall be shewn by the drawings and specifications fyled with the association.

2. Every generator shall be of suitable capacity, substantial construction and on approved principles, the interior parts easily and readily accessible for examination, double generating chambers required, as there is no means of telling whether carbide is exhausted and gas may give out after dark.

3. All danger of corrosion must be eliminated and no copper or any alloy thereof to be used in the machine.

4. There must be no possibility of escape of gas whilst the charge of carbide is being renewed.

5. In generators where the carbide is alternately dipped into, and raised out of the water, suitable precautions shall be taken to prevent the carbide being accidentally precipitated into the water, and thereby causing a too rapid generation of gas.

6. In machines where the pressure of the gas causes an inverted vessel to rise and fall inside of another that contains liquid, the clear space between the two shall be at least one inch all round, not only to secure free motion, but that the surface of the water may be plainly visible without the aid of a glass tube.

7. Liquid seals must be in their natural condition, not liable to be thickened by deposit of lime or other foreign matter.

8. The liquid seals (except those from which the gas is properly piped away) shall be of sufficient depth to resist any possible pressure of gas inside the generator, and in no position shall they be less than six inches.

9. The supply of water to the carbide shall be immediately and automatically cut off before the pressure of gas inside the generator exceeds three inches of water, and a properly protected water gauge, or gauges, shall be so placed as to show the actual pressure of gas inside the generator and gasholder.

10. Suitable escape pipes must be provided, through which the gas shall freely and safely pass from the generator and gasholder into the external air at a pressure not exceeding three inches of water, and before it becomes possible for it to escape by any other means.

11. The pipes for the conveyance of gas from the generator to the gasholder, and those for the escaping gas, shall be at least one inch internal diameter.

12. The apparatus must he located in a dry room, without artificial light or fire heat, and have good ventilation to the outer air near the ceiling.

13. The generator must be charged and the deposit removed by daylight.

14. The deposit, when removed from the generator, to be placed at safe distance outside the building, as the same may contain carbide that is not entirely decomposed.

15. The use of liquid acetylene or of gas generated from liquid acetylene is absolutely prohibited, also lamps from which gas is generated from carbide therein.

16. STORAGE OF CARBIDE.—None permitted inside building, except in generator room, and then only in air tight metal cases, each case to contain only one charge, and the total quantity shall be limited to the requirements for one week, and in no case exceed 50 lbs.

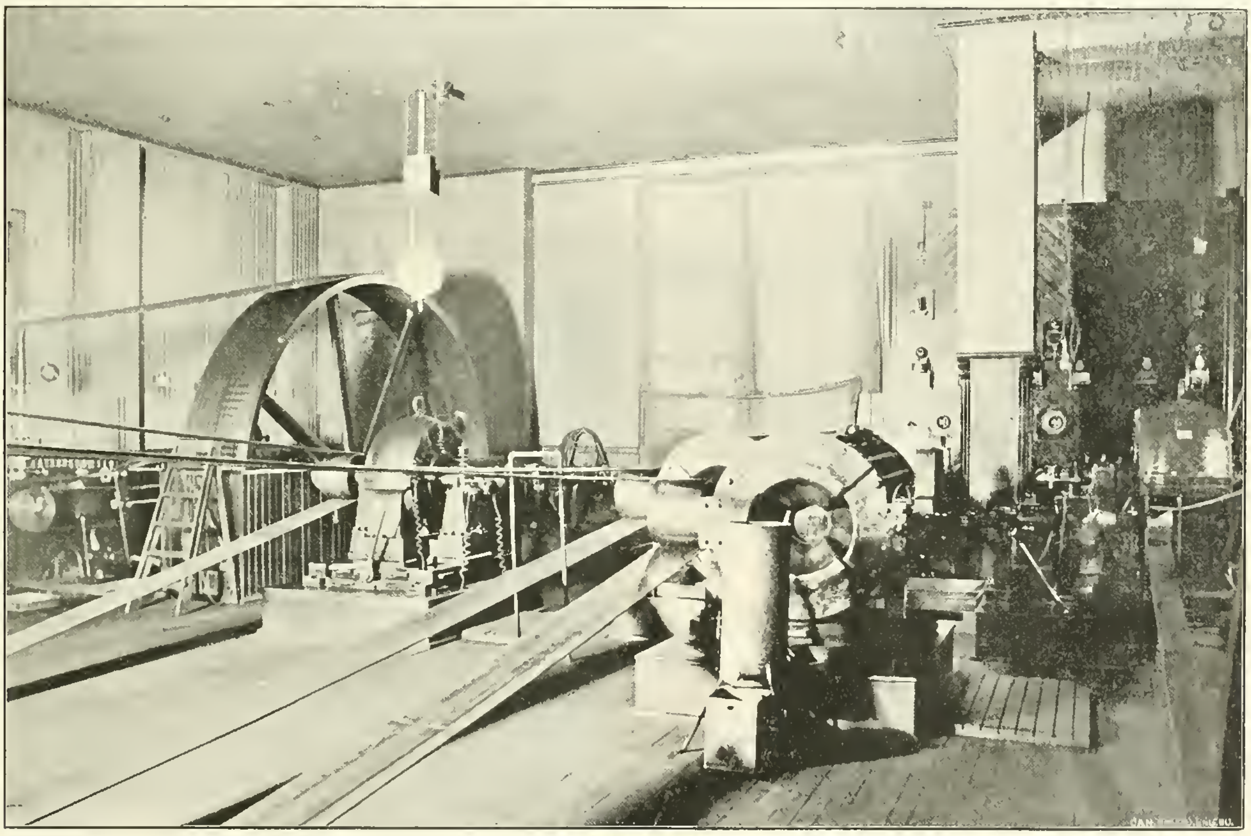
New Westminster Lighting Station.

MUNICIPAL ELECTRIC LIGHT PLANT AT NEW WESTMINSTER, B. C.

[Description Furnished by the City Authorities.]

New Westminster, British Columbia, was the first city on the Pacific Coast and one of the first in Canada—to adopt the principle of municipal control of electric lighting both for street and commercial purposes. It was not without a struggle, however, that the desired end was attained. Early in 1890 a private company came forward with a proposition to furnish the corporation with fifty 2,000 c. p. arc lights at a rate of 45 cents per night each. This would have cost the city over $8,000 a year; but the number of lights required to light the city properly was at least 90, and these would have cost, at the same rate, in the neighborhood of $15,000 per annum.

The question of the municipal control and ownership of the water and light franchises had already received a good deal of attention from the public, and New Westminster at this time had decided upon controlling the public water service. A system of waterworks was under construction and was soon afterwards completed at a cost of about $450,000, which system is to-day one of the best on the continent. The city council of 1890 was composed of a set of thoroughly wide-awake business men, and they decided, with commendable promptness, in order to be first in the field, to proceed at once with an electric lighting system. Like the sentry who was ordered to "shoot first and challenge afterwards," the council, without proper legal authority, entered into the necessary engagements for buildings and plant, and afterwards applied to parliament to legalize the expenditure, which was done.



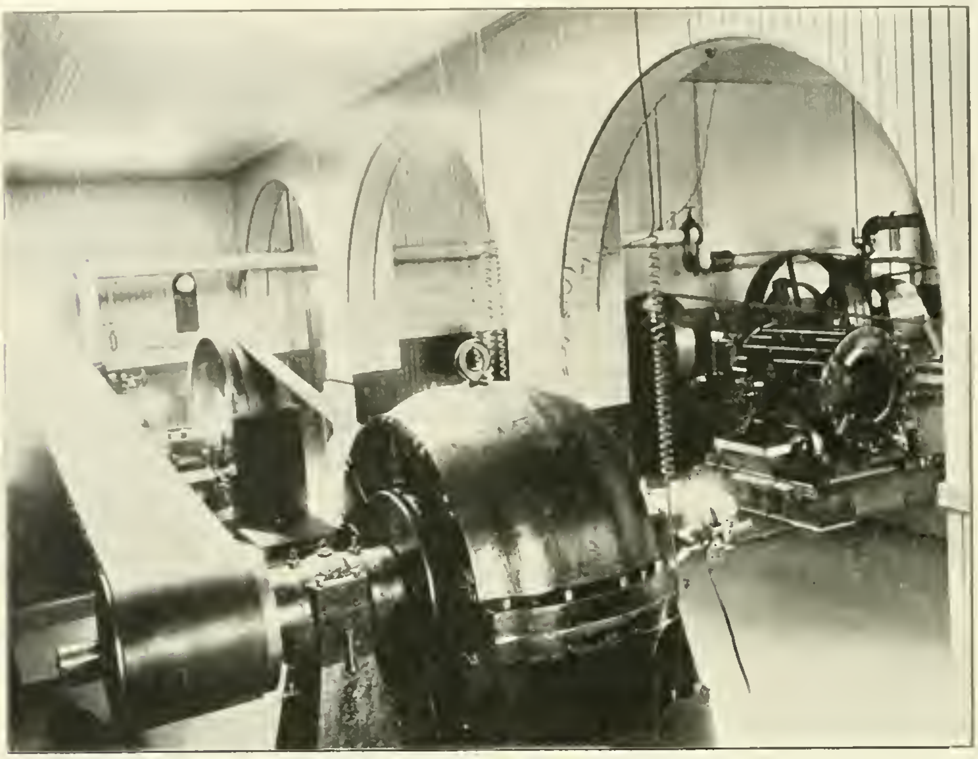
New Westminster Lighting Plant, Showing Corliss Engine and Arc Dynamos.

The result has been entirely satisfactory, and to-day he ratepayers of New Westminster would not, under any circumstances, permit the lighting franchise to pass out of the control of the corporation. The city is one of the best lighted on the continent, and the actual cost of street lighting to the ratepayers has been reduced to a mere trifle. The success of the enterprise was, of course, due very largely to the ability of the management, and to the hearty and generous support of the public.

When it was decided to proceed with the works, the Council's first step was to secure the services of a skillful electrician to superintend the construction. Mr. P. Bowler, an expert from the Royal Electric Company, of Montreal, was finally engaged, and the selection, as events have since proved, was a most judicious one. On the completion of the installation Mr. Bowler assumed full control of the system, and still holds the office of city electrician.

A substantial brick building, two stories in height, 60 x 100 feet, was erected in a central location for a lighting station. The ground floor was divided into two apartments,—boiler room 60 x 40 feet, and engine and dynamo room 60 x 60 feet—separated by a 12 inch brick wall. The upper story has been fitted up with the necessary appliances for repairs, which are all done on the premises, even to the re-winding of the armatures, by the regular staff, and so far the electrician has had no occasion to send any part of the electrical apparatus out of the building for repairs.

In 1890 the plant put in consisted of one 180 h. p. Reynolds Corliss engine, size 20 x 42; two Inglis 80 h. p. boilers, with one 150 h. p. feed water heater; one 50 light 2000 c. p. arc dynamo, and one 650 16 c. p. incandescent dynamo. The engine is belted to a counter shaft, and the dynamos in turn are belted from the counter shaft. Forty 2000 c. p. arc lights were at once installed for street lighting, and ten were reserved for commercial purposes. The demand for incandescent lighting was brisk from the first, and within four months the incandescent dynamo was overloaded, with applications for light still coming in. The city was growing rapidly and the council of 1891 found itself compelled to increase the capacity of both the incandescent and street lighting at once. The ratepayers did not hesitate to vote the additional sum required. The plant was increased by two additional 80 h. p. Doty boilers; one 150 h. p. high speed Doty engine; one 1500 16 c. p. incandescent dynamo, and one 50 light 2000 c. p. arc dynamo, with the necessary lamps. The number of street lamps was then increased to 90, and ten months later the incandescent system was again overtaxed.


No. 1 Alternator, New Westminster Lighting Plant.

When the works were first established the rate for incandescent lighting was fixed at $1 per 100 ampere hours where meters were used, and a fixed rate of $1.12 for 16 c. p. lights where meters were not used, both rates being subject to a discount of 20 per cent. for prompt payment. The works in 1892 were producing a larger revenue than anticipated, and it was considered advisable to reduce the rates for private lighting to 78 cents per 100 amperes, with the same rebate, and this rate still prevails.

The reduced rates produced an increased demand for light, and in 1893 the council was again compelled to reinforce the plant by adding another 1500 light machine and a 150 h. p. Ideal engine. Since then no additions have been made, although the still increasing demand will speedily compel a further extension of the system. The cost of the system as it now stands is $116,441.62.

Mr. P. T. Bowler,
City Electrician, New Westminster, B. C.

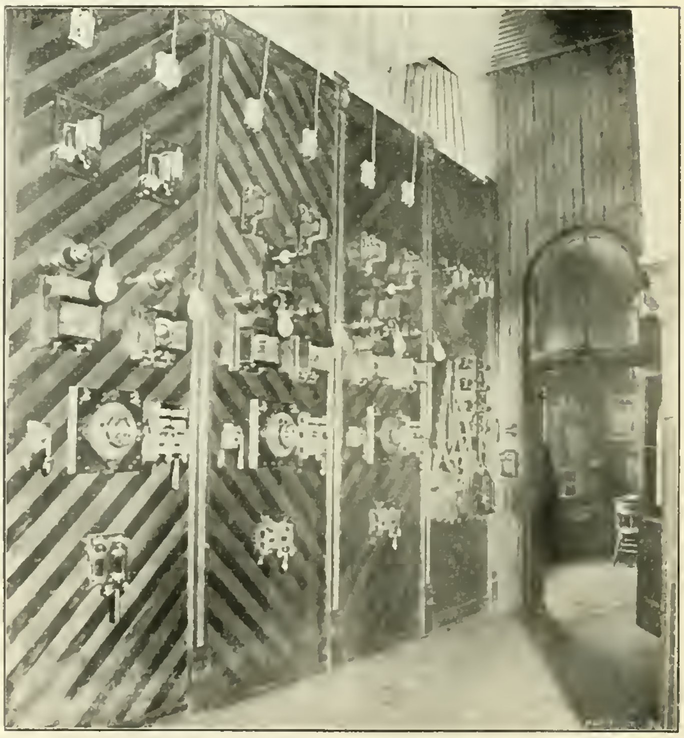
All the electrical apparatus was supplied to the corporation by the Royal Electric Company, of Montreal, and has given good satisfaction.

The following figures will show how the revenue has increased annually since the inauguration of the system:

1891	$10,520.67	1895	$22,838.77
1892	18,221.15	1896	27,535.40
1893	22,167.39	1897	30,756.98
1894	21,585.05		

In 1897 returns were highly satisfactory. The revenue from private lighting amounted to $19,642.73, and street lighting, with a rate of 35 cents per lamp per night, produced $11,114.25, or a total of $30,756.98, against receipts of $27,535.40 in 1896. The expenditure in 1896 was $21,327.61, and in 1897 $21,388.22. Thus with an increased expenditure of only $60.61 an increased revenue of over $3,000 was produced. Let us now deduct the total expenditure from the total receipts, and a profit of $9,374.76 remains. Deduct this profit from the charge for street lighting, and it will be found that street lighting in 1897 cost only $1,739.49, or about five cents a night for each 2000 c.p. lamp. Another year of this progress, and not only will New Westminster be getting street lighting free, but there will be something over to go into the general revenue.

The 1897 expenditures were made up as follows: Interest, 5 per cent. on $116,000; clerk, 12 months at $35, $420; electrician, 12 months at $125, $1,500; engineer, 12 months at $80, $960; assistant engineer, 12 months at $65, $780; dynamo tender, 12 months at $62.50, $750; two firemen, 12 months at $57.50 each, $1,380; two trimmers, ditto, $1,380; one cleaner, ditto, $690; one wireman, ditto, $690; one wireman, 12 months at $40, $480; fuel, 12 months, $2,700; car-


Switchboard, New Westminster Lighting Plant.

bons, $500; oil and waste, $300; repairs and new plant, $1,000; miscellaneous, $2,058.22. The fuel used is mill slabs and sawdust delivered in the boiler room by the Royal City mills at the cost above noted.

His Worship Mayor Ovens, in his inaugural address to the city council on January 3rd, 1896, very accurately stated the present position of the electric lighting problem in New Westminster in the following words: "The rapid growth of our electric light business now brings us face to face with the necessity of either increasing the present plant or refusing new business. It would be most undesirable to check the growth of an enterprise which in a year or two promises to pay a handsome profit after giving us our street lighting free of cost. There are two ways out of the difficulty. The first is to add to the present plant; the second is to make use of some convenient water power and bring the current to the city by cable. By adopting the latter plan, the cost of maintenance would be reduced by one-half, and as we would then have an uninterrupted service day and night, the revenue could be largely increased by supplying motive power to factories, elevators, etc."

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

TORONTO NO. 1.

At the open meeting, Feb. 15th, Bro. Wickens continued his talk on the steam engine indicator, and at the close was tendered a hearty vote of thanks.

At the regular meeting the Legislative Committee reported that all the members of the Dominion government resident in Toronto had been written to asking their support for the Engineers' License Law and Boiler Inspection Act, which is to come up at the present session, and a number of them have promised their support. The regular open meeting will be held Tuesday evening the 8th. Mr. St. John has kindly consented to give a talk on the strength of boilers. The president requests a large attendance and invites all engineers to be present.

KINGSTON NO. 10.

A special meeting of Kingston No. 10 was held in Congress hall, on January 26th, 1898. It was called for the purpose of visiting the members of parliament, Mr. B. M. Britton for the city, and Mr. David Rogers for the county, re legislation. The following members of the association were present: President Simmons, vice-president Asselstine, past-president Donnelly, Bros. Hoppins, Blomely, Woodrow, Davis, Tandvin, Linton, Strong, Gascoyne, Selby, Derry, Bajus, Turnbull, sr., Tait and Orr. We also had with us certificated members of the Ontario Association, viz., David Leslie, R. McArdle, James Ross and George Hazlett, of Winnipeg branch. The members proceeded to Mr. B. M. Britton's office, where they were received and made welcome. Upon the arrival of Mr. David Rogers the business was then proceeded with by President Simmons presenting an address, together with a copy of the act, to Mr. Britton, after which Bro. H. Hoppins, in a few well chosen remarks, presented a copy of the address and the act to Mr. David Rogers. Both gentlemen made a very courteous reply. After a few questions were asked and answered regarding the working of the association, Mr. Britton said he would support the bill, and that he would also give any assistance he could to make it a success. Mr. Rogers said that he could see no objectionable feature in the bill, but he would not pledge himself until he made further enquiries. At a regular meeting held on the 3rd of February a resolution was passed that a hearty vote of thanks be tendered to Mr. B. M. Britton and Mr. David Rogers for the kind reception they gave the deputation of engineers, and also that a copy of the minutes of the special meeting be sent to the ELECTRICAL NEWS for publication.

JOHN L. ORR, Secretary.

ENGINEERS' EXAMINATION QUESTIONS.

As most engineers are desirous of qualifying for a first-class certificate, it is the intention to publish in this journal from time to time, explanatory answers to the questions that have been asked on recent examination papers by the Ontario Association of Stationary Engineers, Montreal City Inspector and other associations by whom a standard of qualification is required. It is hoped by this means to assist engineers in fitting themselves for examination. Herewith is given an answer to the first question asked on the examination paper of the city of Montreal:

QUESTION 1. What is the highest safe working pressure of a common horizontal tubular boiler, made of ½″ steel, with an ultimate tensile strength of 60,000 pounds per square inch of section. Factor of safety, 5; double rivetted. Length, 14 feet, diameter, 66 inches, and 76 three inch tubes?

ANSWER: The strength of a boiler is the strength of its weakest part, which is evidently on the lines of rivet holes, where a certain amount of the entire plate has been removed by the punch or drill. Many eminent engineers, such as Fairbairn, Kirkaldy and Elder, have experimentally investigated this subject, and the mean results arrived at on boilers as usually made, were that with a double rivetted joint the loss of strength mainly due to the rivet holes, is 30 per cent. of the entire sheet, and with single rivetting 44 per cent. This increased loss of strength with single rivetting is due to a distorting leverage, caused by the tendency of internal pressure to bring the centre of the plates in line. In double rivetting this effect is greatly resisted by the increased lap of the joint. The above results, put in a better form for practical use, are, that the strength of a double rivetted boiler is 70 per cent. of the solid sheet, and if single rivetted 56 per cent.

In the question the factor of safety is 5. This means that the greatest tensile stress that the material of the boiler is to be subjected to when at work is one-fifth of the ultimate or breaking stress. This amounts to 12,000 pounds per square inch of section of the plate, of which, owing to the joints, 70 per cent. in double rivetting is the highest permitted, and 56 per cent. in single rivetting. Now, 70 per cent. or seven-tenths of 12,000 is 8,400, which is the greatest tension in pounds per square inch of plate section that is permitted.

The sectional area of ½-inch plates per lineal inch is one-half of a square inch. At a tension rate of 8,400 pounds per square inch, the equivalent rate per lineal inch of plate is 4,200, and this is the highest tension allowed. Leaving algebra and integration in the books, it can be practically proved that in a circular boiler shell the tension per inch in pounds on a longitudinal line, or a line parallel to the centre line of the boiler, is equal to the pressure per square inch multiplied by the half diameter of the shell in inches, and also that the tension on a ring line is exactly one-half of that, provided the head sheets are entire. But, by subtracting the surface removed for the insertion of flues or tubes, the proportion becomes still less. It is for this reason that in calculations on the strength of circular shells no attention is paid to ring lines. The question now takes this form: What number multiplied by 33 gives a product of 4,200? Dividing 4,200 by 33, the quotient is 127.27, which is the answer to the question in pounds.

Irrespective of the thickness of plate or the diameter of boiler, in calculating the safe working pressure of double rivetted boilers, with plates of 60,000 pounds tensile strength, the number 8,400 is, during the process, always arrived at, and hence may be used as a constant. The following table goes a step further, the constants being on the same basis, but in proportion to the thickness of plate, and all that is required to answer such questions is to divide the constant opposite the thickness of plate by the half diameter of the boiler in inches:

Constant for ¼″ sheets	2100
″ ″ 5/16″ ″	2625
″ ″ ⅜″ ″	3150
″ ″ 7/16″ ″	3675
″ ″ ½″ ″	4200
″ ″ 9/16″ ″	4725
″ ″ ⅝″ ″	5250
″ ″ ¾″ ″	6300
″ ″ 13/16″ ″	6825
″ ″ ⅞″ ″	7350
″ ″ 1″ ″	8400

Examples: What is the highest safe working pressure of a boiler of the above description, 42 inches diameter and plates ¼″ thick? Constant 2100, divided by 21, gives 100 pounds.

What is the highest safe working pressure of a boiler of the same description, 72 inches diameter and plates ¾″ thick? Constant 6300 divided by 36, gives 175 pounds.

If these boilers had been single rivetted the base constant would be 6720 instead of 8,400, and in the first example the highest allowed pressure would be 80, and in the second 140.

A valuable addition to engineering literature is the Engineers' Manual, compiled and issued by Toronto branch No. 1 of the Canadian Association of Stationary Engineers. The book bears evidence of being carefully prepared, and the many tables and other valuable data contained therein has apparently been selected with a view of furnishing to Canadian engineers a work that would be of every-day service. A special feature is the electrical department.

THE INDICATOR.*

By A. M. Wickens.

(No. 3.)

Many of you will remember that in our first "Indicator" talk, we examined the instrument and attempted to show how it was constructed, what were the particular functions of its different parts, and the necessity of keeping all in perfect order. Our second talk took the form of applying our indicator to an engine, with piston and valves tight and valves correctly set, and I have no doubt but that some of you will remember the appearance of the diagram we made. For this evening we will take up the reading of the diagrams, and the application of the hyperbolic curve to them—what is known as Boyle's law, or the law of the expansion of gases.

In this the pressure of a gas at a constant temperature varies inversely as the space it occupies, or in other words, double the volume, and you reduce the pressure one-half. This action is plotted out upon the diagram in the shape of a curve, and where everything is correct the steam expansion curve should follow very nearly to the theoretical one. This can only be attained when the engine and valves are in perfect order; and the steam should not contain more than 2 per cent. of moisture. It is not possible to read a diagram correctly without applying this curve to it; even if you know from the appearance of the diagram that something is wrong, you cannot tell how bad it is without applying this curve. One of the greatest troubles in applying the curve is that we do not know the volume of our clearances in our cylinders, for to be really correct it is necessary to know the amount of clearance; for instance, if we apply the curve regardless of clearance it would start from the wrong place and finish the same, and if the clearance was 4 per cent. of the piston displacement, our curve would be that much out of place, which would lead us to a wrong conclusion. If we intend to figure the water consumption as accounted for by the indicator, it is absolutely necessary to take the clearance into the problem.

There are several ways in which the curve may pe put upon the diagram, one by figuring the pressure for the different volumes, and another by geometrical means. I will apply both means to the same card, and we will see how they come out. In all calculations and measurements in connection with the expansion of steam, it is necessary to work from a line of perfect vacuum; this line you can put upon any card by measuring below the atmospheric line with a scale of the spring used to take the diagram, 15 lbs., then from this line we measure or figure.

Take diagram No. 1 upon the board; the cut-off occurred at one-ninth of the stroke. The spring used to take this diagram was a 16, so that each sixteenth of an inch represents 1 lb.; now, fifteen-sixteenths of an inch below the atmospheric line, marked A, we draw another line parallel to it; this is the line of perfect vacuum, and all our work must be done from it. We now apply the scale, and measure from it to the top of the diagram, and find we have 6¼"—this represents just 100 lbs. pressure. We had this pressure when the steam valve closed at one-ninth of the stroke; then at two-ninths of the stroke we would have 50 lbs., at three-ninths 33.3 lbs., at four-ninths 25 lbs., at five-ninths 20 lbs., at six-ninths 16.6 lbs., at seven-ninths 14.4 lbs., at eight-ninths 12.5 lbs., and at the finish of the stroke 11 lbs. pressure. Now, if we measure up from the line of perfect vacuum each of these heights with our scale, and draw a line for each, the curve will just touch the end of each ordinate. If we want to put the curve on graphically, erect a line to represent the clearance, put the line of perfect vacuum on same as before, assume some point where the two lines are to coincide, (say at C, the point of cut-off), draw a line at right angles to the vacuum line that cuts this point, then divide the card up into any number of spaces, making them closer together at point of cut-off. Now, from the intersection of the lines H and V at O, lay your straight edge to point I, and mark upon the line C where it crosses; do the same at each of the other points, then draw lines from each of these points at right angles to the line H, and where they meet the ordinates is the place to locate the curve (do this in two colors). You will therefore see that the expansion curve follows almost the same points by either method.

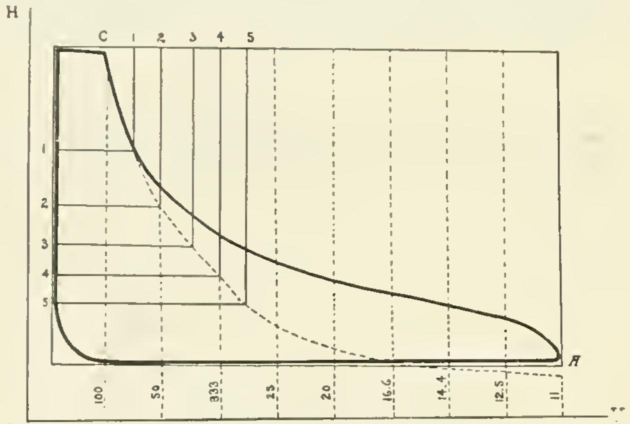


Diagram 1.

We can also figure from the diagram the amount of water used per h.p., or we can measure the steam at any point in the stroke, and from that compute the amount of water used (not all). Now, if we measure the steam just before the exhaust valve opens, we will have the amount of water used.

We will take diagram No. 2, and add the clearance space to the diagram. This clearance we add to the volume of the cylinder up to the point we have picked upon for our measurement (one clearance only). Multiply the volume of cylinder up to point to be measured by the pressure at that point, measured from the line of perfect vacuum. The weight of a cubic foot of steam of any pressure can be obtained from any of the hand books having such a table. This diagram was taken from a Corliss engine, cylinder 16 x 30, running 125 revolutions per minute. The area of this piston is 198.6 square inches. The clearance is four per cent., and amounts to 248 cub. inches. We will fix the point A to be measured, as it is just before the exhaust valve opens, and it is .9 of the stroke, or 27 inches. The volume of steam up to this point is

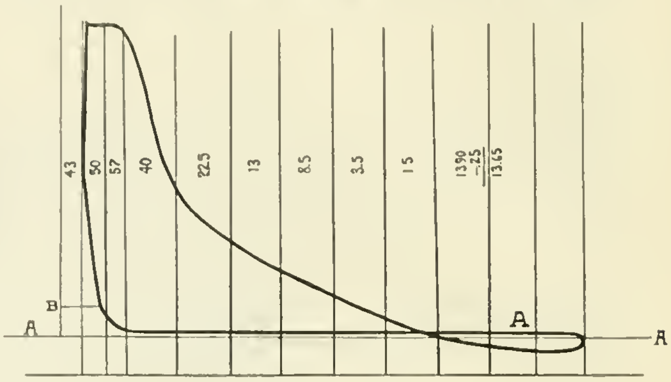


Diagram 2.

$$\frac{198.6 \times 27 + 248}{1728} = 3.2466 \text{ cub. ft.}$$

The pressure at A is equal to 13.5 lbs. and the weight of a cubic foot of steam at that pressure .035 of a pound, so we have 3.2466 × .035 = .11363 of a lb. This is the weight of the steam used each time the cylinder is filled. From this is to be deducted the amount of steam saved by compression in closing the valve before the stroke is finished. We will take a point on the diagram say at B; this point is such that we know the exhaust valve has closed, and we find that it represents about 1.28 in. on the return stroke—this is about three-eighths of an inch and is bearing the same proportion to .9 as 1.28 is to 30 inches, the length of the stroke.

We then have $\frac{198.6 \times 1.28 + 248}{1728} = .29$ of a cub. ft.

The pressure at this point is just 20 lbs. and the weight of a cub. ft. of steam at that pressure is .0511 of a lb.; this multiplied by .29 gives us .01482 of a lb. The weight of steam accounted for per stroke is .11363 − .01482 = .09881 of a lb., and the quantity per hour is .09881 × 250 strokes × 60 min. = 1482.15. Now, how much water per h.p. is this? The constant for this engine will be

$$\frac{198.6 \times 625 \text{ ft.}}{33{,}000} = 3.76$$

The M.E.P. upon the card is 13.65, hence we have 13.65 × 3.76 = 51.32 h.p., and the water per h.p. per hour will be

$$\frac{1482.15 \text{ lb. water}}{51.32 \text{ h.p.}} = 28.8 \text{ lb. water.}$$

We will now compute another diagram from the same engine, No. 3. We use the same constants. The pressure at .9 of the stroke is 26.7 lbs., and the weight per cubic foot is .067 of a lb., then 3.2466 × .067 = .2175 of a lb. The steam saved measured same as before, 20.2 lbs., the weight is .0513 of a lb. Now .29 × .0513 = .0149, and 2175 − .0149 = .2026 of a lb. per stroke. Then .2026 × 250 × 60 = 3040.2 lbs. of water per hour. Our M.E.P. in this case is 38.07; this multiplied by 3.76 = 143.143 h.p., then 3040.2 ÷ 143.143 = 21.24 lbs. water per hour per h.p., or a gain of as 4 is to 3.

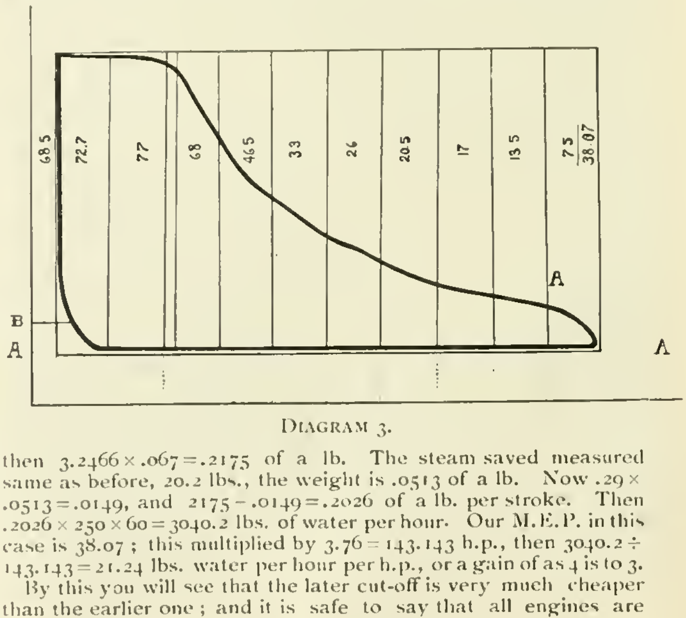


Diagram 3.

By this you will see that the later cut-off is very much cheaper than the earlier one; and it is safe to say that all engines are wasteful at early cut-off, or light loads, and that every cylinder gives us the best economy when the load is reasonably heavy and the cut-off occurring at about one-third of the stroke.

[The diagrams used were taken in actual practice, and for the purpose of the lecture were enlarged to double their original size. As they appear herewith they are about one-half the original scale.—The Editor.]

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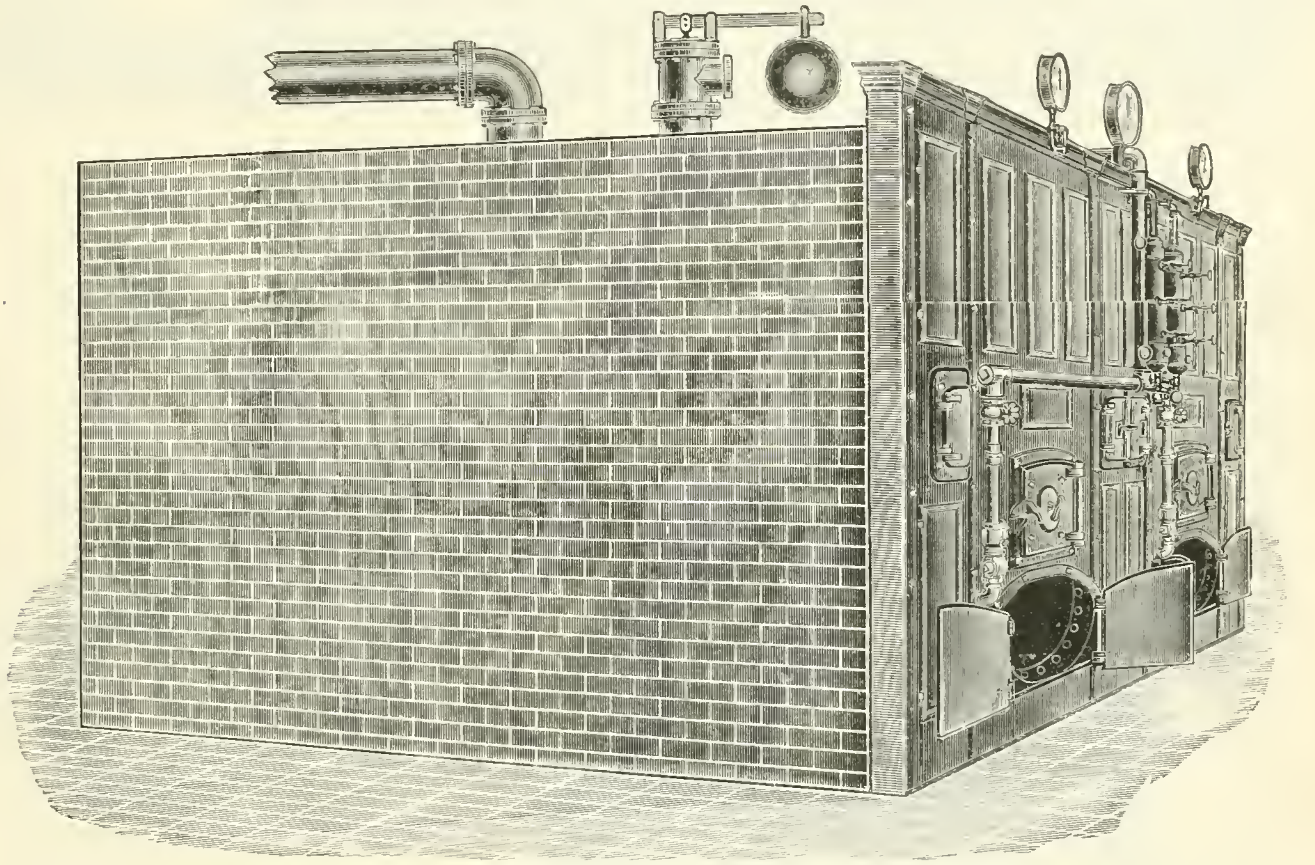
* Paper read before Toronto Association C.A.S.E., February 8th, 1898. (For second paper see Electrical News for December, 1897.)

KINGSLEY WATER TUBE BOILERS.

THE Kingsley patent water tube boilers, herewith illustrated, are constructed with two shells, an outer and an inner. The outer shell has vertical parallel sides and semi-circular top and bottom. The inner shell is fixed parallel to the sides and bottom of the outer shell by means of two flanged heads and numerous stay-bolts, leaving a uniform space about four inches wide between the two shells, extending the full length of the boiler. The crown sheet is horizontal, and extends continuously the full length of the boiler. It is flanged down three inches along each side for its entire length, and forms the top of the inner shell by being riveted to it along each side.

The tubes are threaded at their upper ends with standard pipe threads, and are screwed into the crown sheet. The bottom ends of the tubes are plugged with ¼ inch iron and are then welded solid. The tubes are made of standard 2 inch iron lap-welded pipe. They are short enough in the fire-box to leave an ample combustion chamber, and are longer behind the bridge wall. Any tube can be readily screwed in or out of the crown sheet without touching any other tubes.

The crown sheet is strongly stayed by stay-bolts screwed simultaneously, at various angles, into the semi-cylindrical top of the outer shell and into the crown sheet. These stay-bolts and those connecting the two shells are headed on each end. The parts of the two flanged heads forming the ends of the steam chamber are likewise stayed by rods screwed simultaneously into each, these rods being headed at each end or fitted with nuts.



REPRESENTING TWO KINGSLEY WATER TUBE BOILERS OF 150 H.P. EACH.

The water is contained in the tubes and in the space between the shells, and extends up a few inches over the crown sheet. As this water service extends unbroken for the full length and width of the boiler, no rapid fluctuations of water level can take place, although the boiler is a very rapid steamer. It is possible to supply any capacity of water or steam space by extending the outer shell upward above the level of the crown sheet to any desired height. It is sometimes desirable to thus increase the steam space where large volumes of steam are required at one time, which occurs in various industries.

Regarding the construction and efficiency of this boiler the manufacturers say: No steam drum is used on these boilers. This is claimed to be an advantage over most water tube boilers, as well as many other types, as a steam drum elevated far above and away from the hottest fire can of itself act only as a condenser, as it is the tendency of steam to cool and condense immediately on leaving the direct action of the fire. In the Kingsley boiler the tubes, being vertical and short, liberate steam very freely, and without friction or impediment, which in all water tube boilers with inclined tubes causes a large percentage of water to be carried up with the steam. This is also one reason why this boiler produces dry steam even under the heaviest forcing.

By those who have not investigated, an argument may be advanced regarding the deposit of sediment in the tubes. This, the manufacturers claim, can conclusively be answered by referring to boilers which have been in use for upwards of ten years. One of these, in Chicago, being fed on the dirtiest of feed waters, has been in use for nine years. The users, a short time ago, wrote: "We have never had any trouble with the tubes filling with scale or sediment, but, on the contrary, we think they are brighter than new." Hundreds of tubes have been screwed out and examined for sediment, in various parts of boilers which have been running for different periods, and have been found perfectly clean; in fact, any scale formed in manufacturing the tubes appears to be loosened and removed by the ebullition and rapid currents when the boiler is under steam. After such investigations there can be no reasonable doubt on this point. The reason for this exceptional cleanliness of the tubes is clear when we consider the construction of the boiler. The feed water, entering at the front of the boiler, between the shells, below the level of the grate-bars, in passing up becomes intensely heated before reaching the crown-sheet. It is well known that water, heated to a few degrees above the boiling point, parts with most of its impurities, as mud and carbonates of lime; and at a temperature of about 300 degrees Fahrenheit, equal to 52 lbs. steam pressure, it can no longer retain in solution the sulphates of lime, magnesia, etc., which form the much-dreaded scale in boilers. In this boiler these impurities, being separated by the intense heat, precipitate into the space between the cells, at the bottom of the boiler, where the heat is not sufficient to bake them into scale, and whence they can be washed out occasionally through the hand holes. This boiler is, therefore, by its construction, a perfect feed-water purifier, and no sediment or scale can gather in the drop tubes, because only purified water reaches the crown-sheet from which the tubes are supplied.

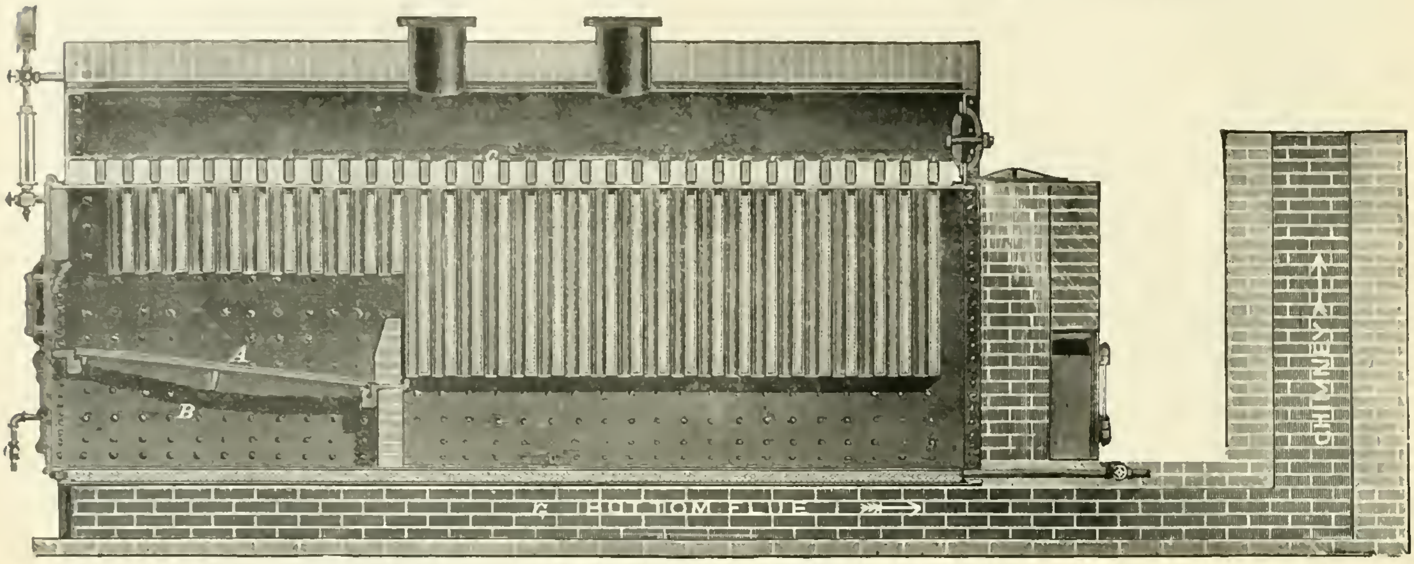
The boiler, being internally fired, has the fire-box entirely surrounded with a water-jacket. The incandescent gases from the fuel, passing up among the short tubes in the fire-box, are drawn backward among the long tubes to the end of the boiler, whence they divide and return, half on each side, between the outer shell and the brick casing towards the front of the boiler. From this point the now nearly exhausted gases can either be carried by means of a saddle over the front of the boiler direct to the chimney, or they can pass down into a flue under the boiler along to its back end, and thence to the chimney. There is no appreciable difference in economy of evaporation between these two methods of circulation of the gases. The tubes are "staggered" in the crown sheet and are spaced at such distances that the gases which pass zig-zag and strike each tube at right angles, while being confined on all four sides by the water-jacketed shell of the boiler, lose nearly all their available heat before they are returned on the sides. For this reason this boiler can be operated also as a locomotive boiler. The gases are passed out of the chimney only sufficiently hot to ensure a good draft.

This boiler requires the same size of chimney as any other type of boiler. For hot water heating for buildings there is no change in the construction of the boiler, the steam space being simply filled to the top with water. The fuel economy is the same as for steam purposes. The circulation of the water is the most direct that can be desired, as there is a continual uninterrupted rise from bottom to top of the boiler.

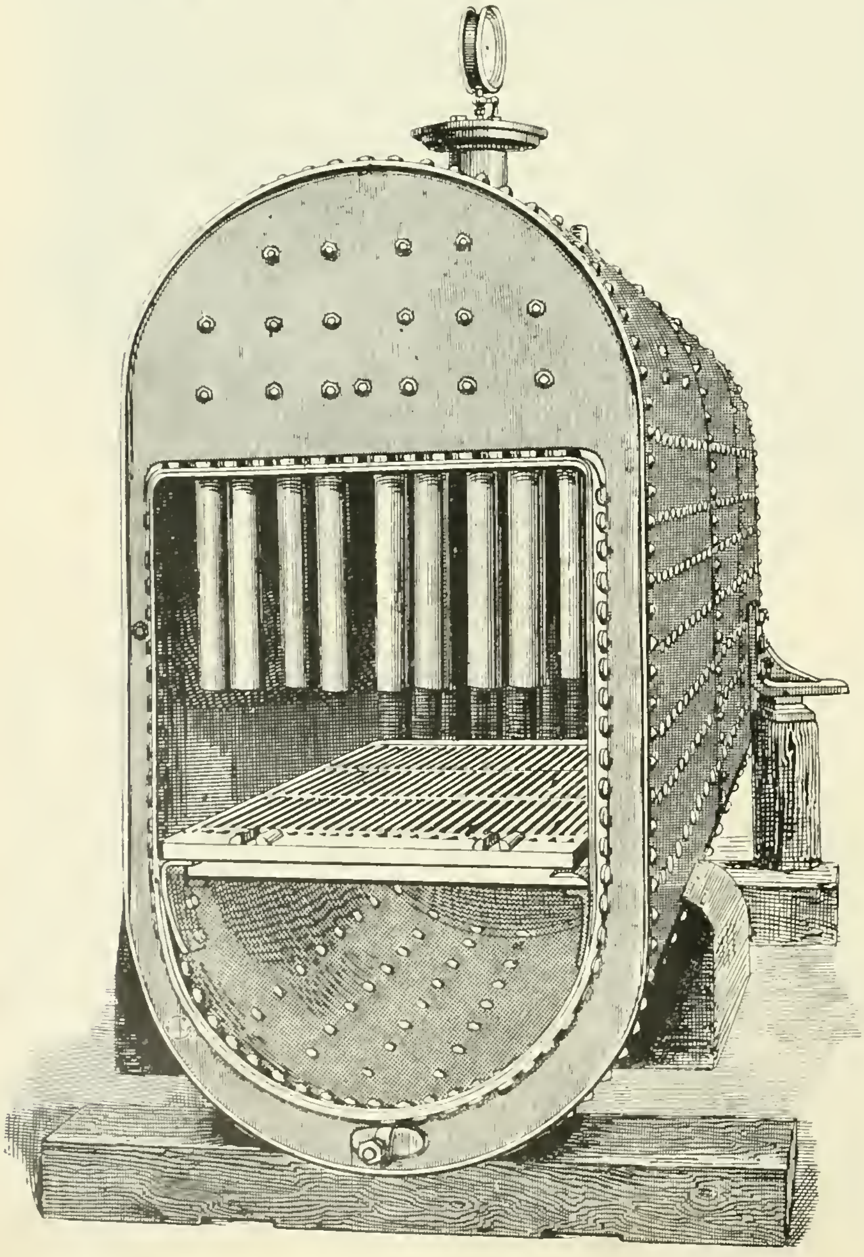
For marine purposes there is no change in the essential design of the boiler, the difference being in details and setting, as the brick casing could not be used. It has been installed for the highest pressures, and is as easily cleaned and as durable as any boiler made.

The economy of installation is apparent when we note that this boiler occupies one-third less ground area than the other ordinary types of horizontal water tube boilers or the return tubular boilers, and less than one-half their cubic contents. It requires only 6½ feet in height. The brick casing is used only for the return gases, and hence never requires renewing. As there is no fire-brick furnace to renew periodically, the repairs are reduced to an absolute minimum.

It is not necessary to refer to the exceptionally high evaporative economy of this boiler, as this could be readily predicted from its construction. The advertisement of this boiler will be found on another page.



Longitudinal Section, Kingsley Water Tube Boiler.



Front End View of Naked (Kingsley) Boiler Ready for Water Test.

TRADE NOTES.

The Montreal Electric Co. have recently removed to more commodious premises at No. 1898 Notre Dame street.

The Richmond County Electric Co. has purchased a 60 k.w. S. K.C. two-phase generator from the Royal Electric Co.

The Buckingham Reduction Company, of Buckingham, Que., is installing a 200 k. w. power generator. The order was given to the Royal Electric Co.

The Ossekeag Stamping Co., of Hampton, N. B., has purchased from the Royal Electric Co. a 200-light incandescent plant for lighting their works.

W. B. Davey will immediately commence operations for the lighting of Grand Forks, B.C. The order for the electrical machinery complete, including a 1,500-light alternator, has been given to the Royal Electric Co.

The T. & H. Electric Co., successors to Kay Electrical Mfg. Co., report recent sales of electric motors from 1 to 15 h.p. to the following firms: Norton Mfg. Co., Max Bernstein, Leitch & Turnbull, Bain & Sache, Electric Light & Power Co., G. H. Meakins, Domestic Specialty Co., Tolton & McKay, City Brass Foundry, Hand & Teale, Post-Office, Geo. D. Membery; also a 20-light dynamo to Bain & Colville, a 400 gal. plater to the Ontario Plating Works, and a 150 gal. plater to D. Moore & Co., Limited.

A very satisfactory statement is presented by the annual report of the Canadian General Electric Company for the year 1897. It shows the company to be practically free from debt, and to have assets of $1,278,258.47. Dividends at the rate of six per cent. per annum were paid 30th June and 31st December, and the sum of $40,000 was carried forward to reserve fund. The volume of business during the year was exceptionally large, while the value of overholding contracts in process of completion is more than $100,000 greater than at the close of the previous year.

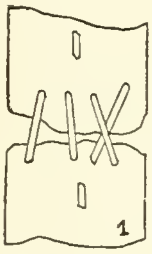
The Packard Electric Co., of St. Catharines, have established a club house and recreation grounds for the use of their employees. The club house consists of two rooms finished in natural wood oiled, and with a large old-fashioned fire place. The grounds are extensive, and have a rink for winter sport, and a field for lacrosse, etc., for summer sports, also provisions for bathing. Mr. E. E. Cary, manager of the company, was elected Hon. President; Mr. Bingay, president; Frank Adams, vice-president, with a complete staff of officers. Suitable by-laws were adopted. It is gratifying to record this evidence of friendly relationship between employers and employees.

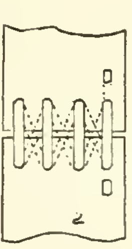
The contract for street lighting in the town of Lindsay, Ont., expires on May 1st next, and a resolution has been passed in the Council authorizing the Fire and Light Committee to obtain particulars as to the cost of an electric light plant to be operated by the town.

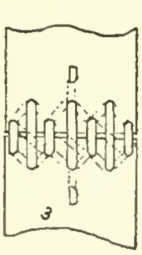
POWER AND TRASMISSION KINKS.

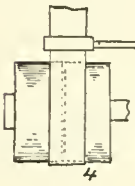
In order to get the most out of any power transmission, the belting and all mechanical parts must be run to best advantage. If belted with a loosely laced belt like that shown in Fig. 1, the system will not run well, as the splice, being open, will slip upon the pulleys. The samples given in Figs. 2 and 3 show the plan of procedure which may be followed by the crosses on the back which are represented by the dotted lines. By thus making good, substantial unions that draw the butts of the belt together evenly and securely, less trouble will be had regarding the driving mechanism.

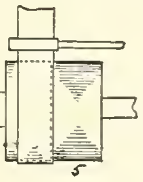
Do not run the belt too tight, as it will strain the bearings, cause friction, and consequently there will be loss of power. If too loose it will be likely to slip on the pulleys and cause loss of time as well as uneven work. It should be slack enough to be readily transferred from the tight to the loose pulley without excessive strain on the shipper. I have often found a machine doing poor work owing to the belt shipper being set as in Fig. 4, in which the belt runs only partly on the tight pulley. Set it to run clear over on the pulley as in Fig. 5.

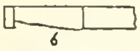


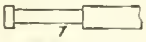


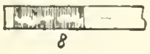


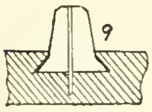


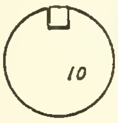


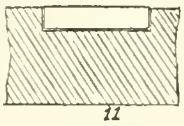


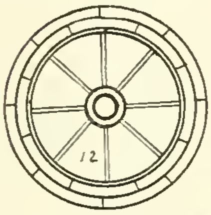


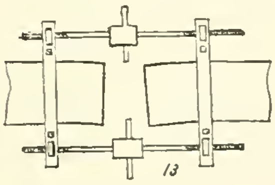


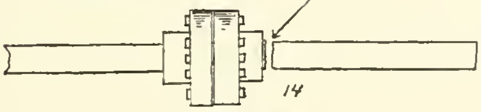


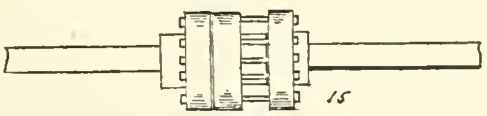












When a shaft it worn down as shown in Fig. 6, take it to the shop and turn it down like Fig. 7, then wind with steel wire as represented in Fig. 8, and a fairly good job will result.

When a cog breaks off of a gear, shape a new cog and dovetail it in, in the manner shown in Fig. 9, and insert a steel pin to prevent the cog from working sidewise. When a bearing throws oil in a place where it is desired that no drippings shall fall, cut a key-way in the centre of the bearing, about half the width of the box, and put in a felt pad as shown in Figs. 10 and 11; the pad absorbs the oily matter.

A lag pulley with wood is shown in Fig. 12, by bolting on sections of pieces cut to correct size to form a smooth surfacing. On the surface put a cement composed of two pounds of black pitch, two pounds glue, one pound linseed oil. I have often travelled far to some mill or shop in response to a call from the proprietor, who has written to the makers of his new machines to the effect that the same do not work right, and upon arrival at the factory have discovered the cause, not in the machines themselves, but through some defect of setting up or starting. The pulleys, for instance, are sometimes the whole source of the trouble through being too small. The builders of the machines cannot tell just what size pulley to furnish always, consequently the selection of the driving pulley often falls to someone at the mill. High speed is the aim nowadays, and yet pulleys of but six or seven inches too small in diameter are frequently used to drive machines. This has many bad effects on both machine and belt. If the pulleys were larger in diameter, the results would be much better. The writer has often proved this to manufacturers by lagging up the driving pulleys on the shaft in the manner shown.

A good belt tightener for large belts is shown in Fig. 13, consisting of the two double end bolts at either side, arranged in the ordinary way, but threaded right and left, so that when turning the centre pivots, both ends of the belt are drawn toward each other simultaneously.

A shaft recently broke short off near a coupling, as shown in sample 14. We desired to run the mill until Saturday night, and as the shaft would not bear shortening, we put another coupling on the broken end, keyed it firmly, and inserted bolts clear through from the former couplings, as shown in Fig. 15, and the mill was kept running.—Power and Transmission.

NEW ENGINEERING SOCIETY.

The members of the engineering staff of the Royal Electric Co., Montreal, have formed an association, to be known as the Royal Electric Engineering Society, the primary object of which is the advancement of knowledge in engineering subjects. At the inaugural meeting on February 14th a constitution was adopted and officers nominated. The membership includes some fifty charter and associate members and twelve honorary members. The meetings are to be held every two weeks from October 1st to April 30th.

The first regular meeting of the society was held on the 24th ultimo, at which officers for the current year were elected as follows: Honorary president, Mr. Wm. H. Browne, general manager Royal Electric Company; president, W. M. Bucke; vice-president, W. T. Dix; corresponding secretary, R. F. Morkill; recording secretary, W. G. Angus; treasurer, L. A. Howland; librarian and curator, F. Cushing; committee, J. Burnett, L. Mudge, K. B. Thornton.

The Auburn Power Company at Peterboro' have ordered a direct connected sub-station unit from the Canadian General Electric Company, consisting of a 75 h.p. induction motor direct connected to a three-phase induction motor. From this outfit current will be supplied at 500 volts to small power users throughout the town of Peterboro', it having been found that the high price of induction motors prevented their general use.

The General Engineering Company of Ontario, Limited, have during the last month purchased the patents and assets of the Weeks-Eldred Co., of Toronto. The capital has been increased to $40,000. J. L. Caverhill, Montreal, has been elected president, and James Milne vice-president and general manager of the new company. The company have closed orders for the equipment of the steamer North King, of Kingston, and Boon's dredge, Collingwood harbor, also the Kingston penitentiary.

The Canadian General Electric Company have closed a contract with the E. B. Eddy Co., of Hull, for a 500 and 350 light multipolar direct current generator for lighting their mills at Hull. With these machines they will install standard marble panels containing instruments of the latest type. The contract also covers the supply of material for the wiring of the place in strict accordance with the latest requirements of the Fire Underwriters.

Mr. G. O. S. Conway, of Stonefield, Que., is said to have been successful in forming a company to develop the water power at Grenville and to erect a pulp mill in connection therewith. The scheme includes the installation of an electrical plant for the purpose of lighting the Carillon and Grenville canals, the villages of Carillon and Grenville, and the town of Hawkesbury, and also to furnish power for the proposed electric railway to operate on the north shore of the St. Lawrence river. It is expected that the final negotiations will be completed in about three months. Exemption from taxation will be granted by the town, and also a bonus of $10,000.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE XI.]

DROP IN POTENTIAL AND SIZE OF LEADS FOR MULTIPLE ARC CONNECTIONS.

(Continued.)

EXAMPLE 12: In Fig. 3 we have represented a pair of mains on which we have to connect four groups of lamps, consisting of five lamps each connected in multiple. The lamps have each a resistance of 200 ohms. The E.M.F. of the terminals to which leads are connected is 110 volts, and it is desired to allow a drop in potential of 10 volts, to be divided equally between each of the four groups of lamps. What must be the resistances of the four sections of wire?

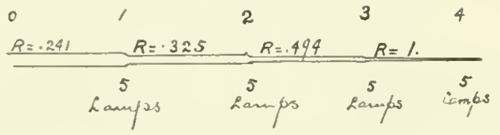


FIG. 3.

Commencing at group 1, we have an E.M.F. of 107.5 volts, at group 2 105 volts, at group 3 102.5 volts, and at group 4 100 volts, with a uniform drop of potential of 2.5 volts between each of the groups. Commencing the calculation at the extreme end of lead, or at group 4, we have 5 lamps connected in parallel, each with a resistance of 200 ohms. Then combined R of group 4 = $\frac{200}{5}$ = 40 ohms, and a total current of $\frac{100}{40}$ = 2.5 amperes. The required R of section 3 to 4 then is $\frac{10}{25}$ × 2.5 = 1 ohm.

Taking now group 3, calculating by similar methods, and bearing in mind the fact that the combined resistances of the whole of the groups must be the same, since the number of lamps in each group are equal, total current of group 3 then is

$$\frac{102.5}{40} = 2.56 \text{ amperes,}$$

And since the current required for group 4 must pass through the wire supplying group 3, we get:

Current of group 4 = 2.5 amperes,
" " " 3 = 2.56 "
Total current wire 2-3 = 5.06 "

The required R of section 2 to 3 then is equal to $\frac{100}{506}$ × 2.5 = .494 ohms.

Taking now group 2 and calculating in exactly similar manner, $\frac{105}{40}$ = 2.62 amperes, and 2.62 + 2.56 + 2.5 = 7.68, total current passing on wire section 1 to 2. $\frac{100}{768}$ × 2.5 = .325 ohms, required R sections 1 to 2.

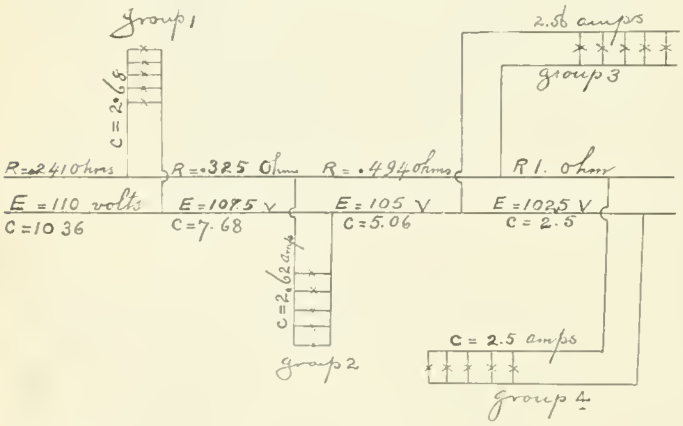


FIG. 4.

$$\text{Group } 1 = \frac{107.5}{40} = 2.68 \text{ amperes, and } 2.68 + 7.68 = 10.36, \text{ total C}$$

passing on wire section 0 to 1. $\frac{100}{1036}$ × 2.5 = .241 ohms, required R sections 0 to 1.

Therefore we find we require, to meet conditions as set forth in our problem, a wire varying in resistance and consequently in area, as shown in Fig. 3, and where

R of section of wire 0 to 1 = .241 ohms,
" " " 1 to 2 = .325 "
" " " 2 to 3 = .494 "
" " " 3 to 4 = 1.000 "

These resistances, divided by twice the length of one side of lead, will equal R per foot required on lead.

Fig. 4 shows the whole of the results of our previous problem in detail, and at the same time it will be seen from diagram that this method of computation can be applied to almost any system of distribution on the two-wire principle, and need not here have further reference.

CALCULATION OF WORK DONE BY PUMPS.

Rule: To find the contents of the pump when full, find the area of the cylinder in inches, multiply by length of stroke in inches, and result will be capacity of pump in cubic inches of water each stroke.

Rule: To find capacity of pump per hour, first find contents of cylinder each stroke, then multiply by strokes per minute, and then by 60; result will be capacity of pump per hour in cubic inches; to reduce to cubic feet divide result by 1728.

Example: Find the contents of a boiler feed pump, stroke being 24 inches and diameter of cylinder 6 inches.

Formula: $D^2 \times .7854 \times L$ = contents; $6^2 \times .7854 = 28.2744$, area in cubic inches; 28.2744 × 24 = 678.5856 cubic inches, contents of pump cylinder when full.

Example: Find the capacity per hour of a boiler feed pump in cubic feet, diameter of piston being 4 inches, stroke 6 inches, and pump making 75 strokes per minute.

$4^2 \times .7854 = 12.5664$ square inches, area;
12.5664 × 6 = 75.3984 cubic inches, contents per stroke;
75.4 × 75 = 5655 cubic inches per minute;
5655 × 60 = 339300 cubic inches per hour;
339300 ÷ 1728. = 196.35 cubic feet of water, capacity per hour.

DETERMINING THE REQUIRED SIZE OF BOILER FEED PUMPS.

This question, as practical engineers will know, covers a wide range of subjects, and it is particularly hard to lay down a hard and fast rule adapted to every condition of service. It might be assumed that the quantity of water accounted for as being used within the cylinder of an engine would be a nearly correct basis on which to arrive at the required capacity of the pump. This, however, for many reasons, is so far from being correct that I have decided not to refer at length to this method of calculation.

Clearly, a boiler feed pump should have ample capacity for all calls that are likely at any time to be made upon it, and with the quantity of water we may be called upon to evaporate per minute or hour before us, we are enabled to arrive at a fair approximation of the required capacity of the pump. Even this must be coupled with a good deal of practical common sense, and provision must at all times be made for leakage on the boiler and its accessories, and leakage and slip within the pump itself.

Example: Find the required capacity of a boiler feed pump for three boilers whose furnaces are 3 feet by 6 feet, coal consumption 15 pounds per square foot of grate surface per hour, and evaporation equal to 10 pounds of water per pound of coal.

6 feet
3 feet
18 square feet surface in each boiler
15 pounds coal consumed per hour
90
18
270 pounds of coal per hour each furnace
3
810 pounds, total coal consumed per hour
10
8100 pounds of water evaporated per hour
8100 ÷ 62.5 = 129.6 cubic feet of water per hour
129.6
4 factor of safety
518.4 cu. feet of water per hour for safety, after allowance for slip, leakage, etc., required capacity of pump.

What must be the diameter of a double-acting duplex steam pump making 100 strokes per minute and having a stroke of four inches to comply with above requirements?

$518.4 \div 60 =$ 8.64 cu. feet per minute;
$8.64 \div 100 =$ .0864 cu. feet per stroke;
$.0864 \times 1728 =$ 149.3 cu. inches, required contents of pump;
$149.3 \div 4 =$ 37.325 cu. inches, required area of cold water piston;
$37.325 \div .7854 =$ 47.5, and
$\sqrt{47.5} =$ 6.88 inches, required diameter of pump piston, or say, 6⅞ inches.

Then, to safely comply with the conditions set forth, we shall require a duplex steam pump making 100 displacements per minute, with a 4-inch stroke and a cold water piston diameter of 6⅞ inches.

MISCELLANEOUS QUESTIONS.

To find extra pressure required to discharge water from a given orifice :—

Formula :

$$\frac{T^2 D^4}{2000000\, d^2\, B^2}$$

Where T = travel of plunger in feet per minute,
D = diameter of plunger in inches,
d = diameter of delivery valve,
B = breadth of opening or lift in inches.

Example : The cold water piston of a pump is 4 inches in diameter and has a travel of 150 feet per minute. The delivery valve is 2½ inches in diameter and has a lift of ¼ of an inch. What extra pressure is required to discharge the water?

$$\frac{T^2 D^4}{2000000\, d^2\, B^2} = \frac{150^2 \times 4^4}{2000000 \times 2.5^2 \times .25^2} = \frac{5760000}{781250} =$$

$$5760000 \div 781250 = 7.37 \text{ pounds.}$$

To find velocity at which water will travel through the discharge pipe of a pump. The velocities are in inverse proportion to the area, or what amounts to the same thing, the velocities are in inverse proportion to the square of the diameters.

Then for the purpose of determining the ratio of velocity between any two pipes we may construct the following formula :

$$\frac{D^2}{d^2}$$

Where D equals diameter of plunger, d equals diameter of pipe. And when the speed of the plunger is known the velocity of the water in the discharge pipe may be determined by formula :

$$\frac{D^2 \times T}{d^2} = V.$$

Where D = diameter of plunger in inches,
T = travel in feet,
d = diameter of discharge pipe in inches,
V = velocity of discharge in feet per minute.

Example : The plungers of a pump are 10 inches in diameter and have a travel of 100 feet per minute. At what velocity will the water travel through a discharge pipe 2 inches in diameter?

Then

$$\frac{D^2\, T}{d^2} = \frac{10^2 \times 100}{2^2} = \frac{10000}{4} = 2500 \text{ feet per minute.}$$

The work done due to the energy of motion of a moving body is represented by the formula :

$$\frac{W\, V^2}{64}$$

Where W equals the weight, V equals velocity in feet per second.

Example : The piston of an hydraulic ram is 12 inches in diameter; water in feed pipe has a velocity of 2,000 feet per minute; feed pipe to ram is ¾ inch. What is the energy of ram per pound of water used?

Velocity in feet per second equals

$$\frac{2000}{60} = 33.33.$$

It has already been shown that the velocity of water in pipes depends upon the areas or diameters squared; consequently $12^2 \div .75^2 = 144 \div .5625 = 256$. That is, 256 is the ratio of velocity of water in feed pipe as compared with the velocity of the water in the ram. Therefore, if the water in the ram moves at the rate of 1 foot per second, the water in the feed pipe must move at the rate of 256 feet per second, and the amount of work done is the same in each case. The difference in areas causes the ram to move only $\frac{1}{256}$ the speed of the pump, and what the ram loses in speed it must gain in force, since energy is indestructible, and the pressure exerted by the ram must be 256 times greater than that in the pipe to make up for loss in speed.

Energy of motion in pipe then equals

$$\frac{W\, V^2}{64} = \frac{1 \times 33.33^2}{64} = 17.35 \text{ ft. lbs.}$$

Then the work done by ram per pound of water used equals $17.35 + 256 = 4441 - 60$ foot pds. per pound of water used.

The pressure due to velocity is found by dividing the square of the velocity in feet per second by the constant 148.3.

Example : The piston of an hydraulic ram is 6 inches in diameter; velocity of water in a ½-inch feed pipe equals 2,500 feet per minute. What is the work done by the ram per pound of water used, and what is the pressure per square inch due to velocity, and if the energy of the water had been turned into heat what would be the rise in the temperature of the water?

Velocity of water in feed pipe per second equals

$$\frac{2500}{60} = 41.33,$$

and $6^2 \div .5^2 = 36 \div .25 = 144$, ratio of velocity in ram as compared with feed pipe;

$$\frac{W\, V^2}{64} = \frac{1 \times 41.33^2}{64} = 26.69$$ foot lbs. energy of motion per pound of water in feed pipe; $26.69 \times 144 = 3843.36$ foot pounds per pound of water used by ram; $V^2 = 1708.16$, and pressure due to velocity in pipe equals

$$\frac{1708.16}{148.3} = 11.51 \text{ pounds per square inch.}$$

Then the pressure on the ram must equal $11.51 \times 144 = 1657.44$ pounds per square inch.

The mechanical value of a British Thermal Unit (B T U) is equivalent to raising 1 pound 772 feet high in one minute, or what is the same thing, raising 772 pounds one foot high in the same period of time; therefore a raise of 1° F. in the temperature of a pound of water equals 772 foot pounds of energy.

$$\frac{26.69 \text{ energy per pound of water in feed pipe.}}{772}$$

equals .0345° F. increase of temperature of water in feed pipe.

Then

$$\frac{3843.36}{772} = 4.98° \text{ F. rise of temperature in ram.}$$

Then if the whole of the energy of the ram had been expended in heat it would have given off sufficient heat to have raised the temperature of each pound of water 4.98° Fahrenheit.

OILS OF THE ENGINE ROOM.*

(Continued.)

We will now take the three main groups—animal, vegetable and mineral—and discuss their constitution and their behavior under the conditions which we will meet with in their use as lubricators. Oils from the animal and vegetable kingdom are fat oils; those from the mineral kingdom are not. In the first group, animal oils, we will find that oils from fish fat predominate, and that oils from other animal sources include in the largest proportion oils from the hog, and the balance will be very indiscriminate, refuse from slaughter houses, fat recovered from soap making, etc. Vegetable oils will be found to be the product of nuts, or nut like fruits. This includes seeds. All seeds contain oil in greater or less quantities, the oil being part of the food stored in the seed for the nourishment of the young plant. Oils are also obtained from the whole plant, as in the case of oil of peppermint, or the leaves, as wintergreen, or the petals of the flower as rose, or the wood fibre as turpentine, or the bark as cinnamon and from roots, so that you will see the oil exists in all parts of plants, but that the main supply is from the fruit. Oils from the mineral kingdom are not fats, that is, they cannot be divided by alkalies. They do not produce glycerine when decomposed as in the case of fats.

We have now ascertained the sources of oils, and will now go into the constitution of them, as this will bring us to the application of the knowledge we have obtained to understanding the changes which take place in oil when used for lubrication.

Animal fats or oils will be the first group to be considered, and under this head we have :

Fish oils—Whale, cod, shark.
Hog products—Lard oil, fat oil.
Horses and Cattle—Candle fat, suet, tallow, olein oil.

Most fats are mixtures of two or more compounds : Stearin, palmitin, olein and cetlin. Fish and other animal oils consist of olein, palmitin and stearin, which compose the fluid portion, and cetlin, the solid portion. Olein is oleic acid, or oleate of glyceryl, and when olein or the fluid part of oil is acted on by hot steam, a separation of glycerine and oleic acid ensues. Olein when mixed with an alkali forms oleate of that alkali, and glycerine is again set free. We will notice by this table that olein is a constituent of nearly all fats—animal or vegetable.

	Olein	Palmitin
Almond Oil............	Chiefly.	Very little.
Olive Oil..............	“	“
Lard Oil..............	“	Palmitin and stearin.
Castor Oil............	Ricinolein.	Palmitin.
Cottonseed Oil........	Olein.	“

Palm oil is composed of palmitin and olein (it rapidly becomes rancid and acquires an acid reaction). Suet is almost exclusively stearin; tallow, stearin and olein.

We observe from this that oils or fats are composed of substances which decompose at a high temperature; hence, while they in many cases would be found of great service in cold bearings, only certain of them would be of use in hot bearings, and it is here that we find mineral oils to be of advantage, as they do not decompose. Cylinder oils ought more especially to be free from decomposable substances, from rancidity, and, in a word, to be of a lubricating nature under the influence of a high temperature in the presence of moisture. The evidence that these oils do fulfill these requirements is that the oils from the exhaust are used again after filtration, etc., showing that it has not been decomposed or destroyed, as would be the case were the oil not to possess sufficient stability.

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* Paper read before Hamilton No. 2, C.A.S.E., by J. W. Williams, chemist for Winer & Co., wholesale druggists.

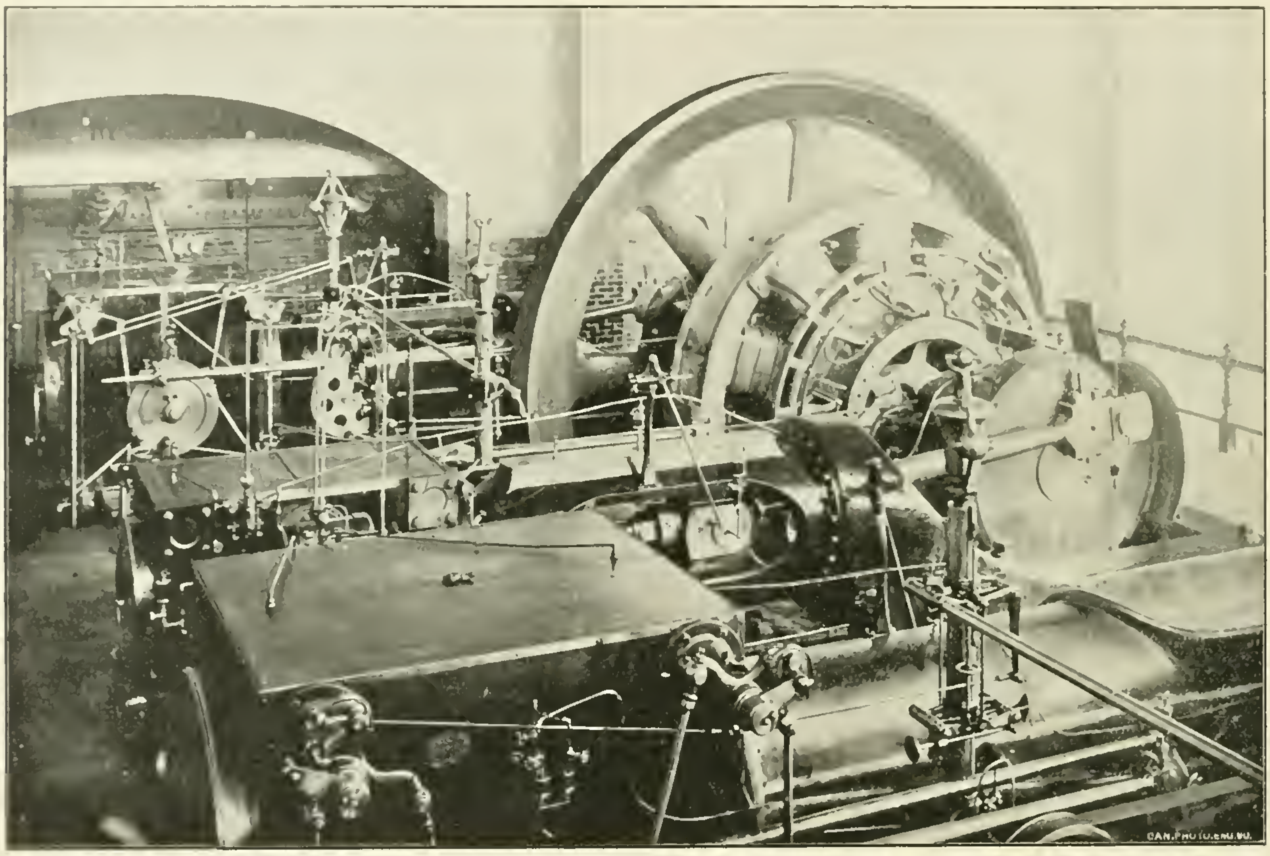
ELECTRIC RAILWAY DEPARTMENT.

DIRECT CONNECTED GENERATORS FOR RAILWAY WORK.

THREE years ago the Canadian General Electric Company installed in the power house of the Toronto Railway Company the first direct connected generator to be used for railway service in Canada, the machine being designed for larger outputs and slower speeds than the belted generators formerly used. It was claimed for this type of apparatus that it was capable of meeting the severest requirements of surface or elevated railway work, and possessed the additional advantage of greater reliability. In practice it must have been found satisfactory, as the Toronto Railway Company recently placed an order with the mannfacturers for a duplicate of the machine, which has just been installed, and is herewith illustrated. A Siemens & Halske machine was replaced by this latter unit.

These generators are of 850 kilowatts capacity each, having ten poles, and operate at 90 revolutions per minute. They have steel frames, the combined weight of which, with pole pieces, is about 80 tons. The armatures are of the iron-clad type and weigh about 25 tons each. The machines are regulated for a regular running load of 1,500 amperes, but by practical operation have been proven to be of much greater capacity. They are of the same type as the 1,500 k.w. generator which has since been installed for the Montreal street railway, the 400 k.w. for the Winnipeg railway, and the two 500 k.w. at Quebec.

The manufacturers claim for them many advantages, among which are the following: Removable pole pieces, facilitating repair of field spools and permitting their removal without disturbing field frame or armature; frames adjustable in every direction; compounding proportional to current, so that machines will operate perfectly in parallel with each other; cool fields and permanency of insulation; commutator separated from armature, giving advantage of deeper segments and securing successful operation of carbon brushes; great number of segments in commutator, reducing volts per bar to a safe minimum and insuring freedom from sparking; armature hub bolted direct to fly wheel on larger sizes, removing strain from shaft and keys; absence of all volts through laminations; armature laminations separated from each other by fire proof insulation, preventing loss from eddy currents and yet maintaining permanent solidity of construction; flexible leads from armature conductors to commutator. A special feature is the barrel winding, a modification of the drum winding, having all the conductors held symmetrically on the cylindrical periphery of the armature. The end flanges extended laterally like a pulley, form a support for the end connections, the conductors being firmly secured in the armature slots and on the end flanges by metal bands, so that vibration is rendered almost impossible.



850 K.W. DIRECT-CONNECTED GENERATOR INSTALLED FOR THE TORONTO RAILWAY COMPANY.

SPARKS.

Mr. Wickstead, engineer, has submitted to the town council of Cobourg, Ont., a scheme to develop the water power of Baltimore creek. The cost of furnishing 400 horse power is estimated at $55,000.

The death is announced of Mr. James Geen, electrical contractor, of Montreal.

The electric light company at Milltown, N. B., recently added a new engine to their plant.

The Bell Telephone Co. are having plans prepared for a new exchange to be built on St. John street, Quebec.

The Hamilton Radial Railway Company is said to have abandoned the idea of extending its road beyond Burlington.

The Winnipeg and Fort Alexander Railway Company is asking for power to build railways, telegraph and telephone lines.

The Toronto Railway Company have just placed an order with the Canadian General Electric Company for 20 G. E. 1000 motors, with K-10 controllers.

Mr. T. H. McCauley, electrical expert for the Royal Electric Co., Montreal, recently installed the new plant for lighting the town of Fort William, Ont.

The British Columbia Railways Company have placed an order for a freight car, using "Brill" trucks and G. E. 1200 motors, with the Canadian General Electric Company.

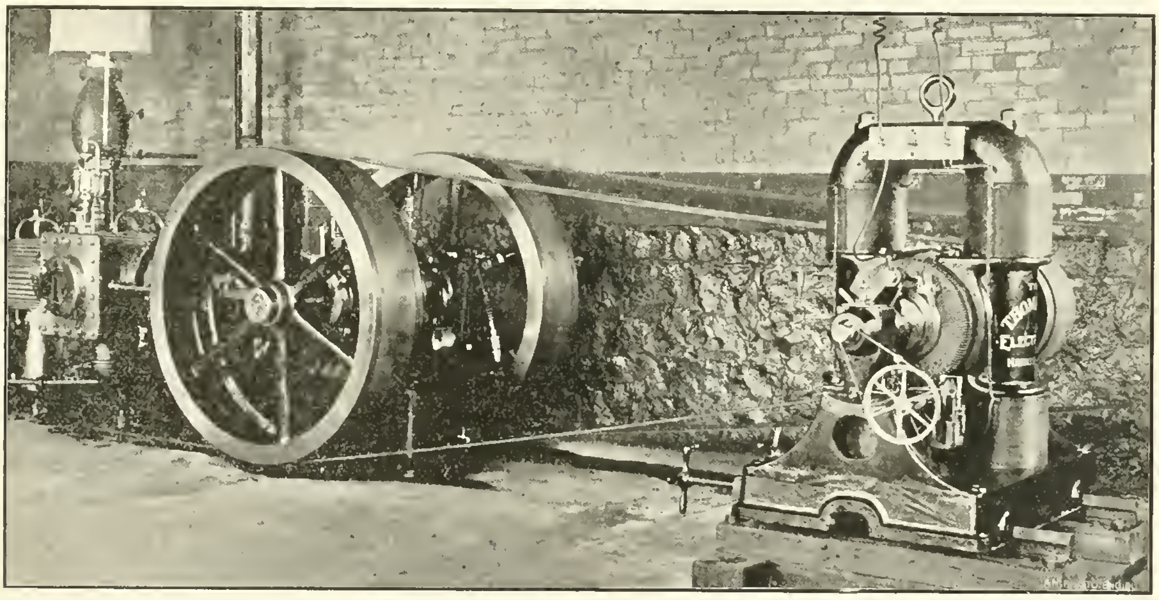
The Canadian General Electric Company will supply the entire electrical equipment for the new St. Thomas street railway. The order covers two 100 kilowatt generators and eight two motor equipments. The contract for cars was given to the Ottawa Car Company, and for the steam engine to the Robb Engineering Company, of Amherst, N S.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII. APRIL, 1898 No. 4.

CHATHAM MUNICIPAL LIGHTING PLANT.

THE year 1897 marked the inauguration of the electric light plant installed, under civic control, for lighting the streets of the city of Chatham, Ont. In February of that year a by-law was carried by the ratepayers authorizing the City Council to expend $15,000 in the purchase of an arc plant. Tenders were subsequently invited and awards made for the same. The contract for the complete electrical equipment, including dynamos, lamps, wiring, etc., was placed in the hands of the Thompson Electric Company, then of Hamilton, but now amalgamated with the Toronto Electric Motor Co., and doing business in Toronto. Messrs. E. Leonard & Sons, of London, were the successful tenderers for the engine, and Park Bros., of Chatham, for boilers. The accompanying view shows one of the arc machines and the engine.



VIEW OF ELECTRIC LIGHT PLANT, CHATHAM, ONT., SHOWING ONE ARC MACHINE AND ENGINE.

The electrical equipment consists of two automatic arc dynamos of nominally 50 lamps capacity each. These are supplying current to 104 arc lamps and 10 series incandescents through circuits which aggregate some 24 miles in length. The 10 incandescent lamps and 2 arc lamps are used for illuminating the power house and adjoining waterworks plant, while 102 lamps are for street illumination exclusively. These latter are provided with substantial telescoping storm protectors, and are suspended from a suitable steel mast arm. Sleet proof lamp-supporting pulleys and thoroughly insulated lamp hangers are used throughout.

The outside circuit throughout is of No. 6 B. & S. hard drawn copper wire, triple braided, strung over double petticoat insulators, and at intervals of two miles is protected by an effective magnetic blow-out lightning arrester. Wherever possible the circuit is divided into loops, comprising some 5 to ten lamps, each loop being controlled from a substantial absolute cut-off switch. The interior wiring is of No. 6 B. & S. rubber covered wire.

A plug switchboard, arranged so that machines and circuits may be interconnected, is provided. This is furnished with ammeters and magnetic blow-out lightning arresters of a new pattern, the whole being neatly arranged on a white marble base.

The plant is said to have been subjected to the most vigorous tests, and to have proved very satisfactory. The machines were short circuited at full load for one minute, and also while at full load the circuits were suddenly opened. These tests thoroughly demonstrated their ability to withstand any exigencies of service.

The engine is a Leonard-Ball automatic compound, of 100 h.p., and is designed with a heavy shrouded frame and box base. The bearings are large and well-proportioned. The engine is well finished and is equipped with a very complete oiling device, making a power plant neat in appearance, silent running and economical.

The Windsor Hotel Company, Montreal, Que., are making extensive alterations in their electric installation, and have ordered from the Canadian General Electric Company two 1,000 light slow speed multipolar generators, with marble switch-board panels.

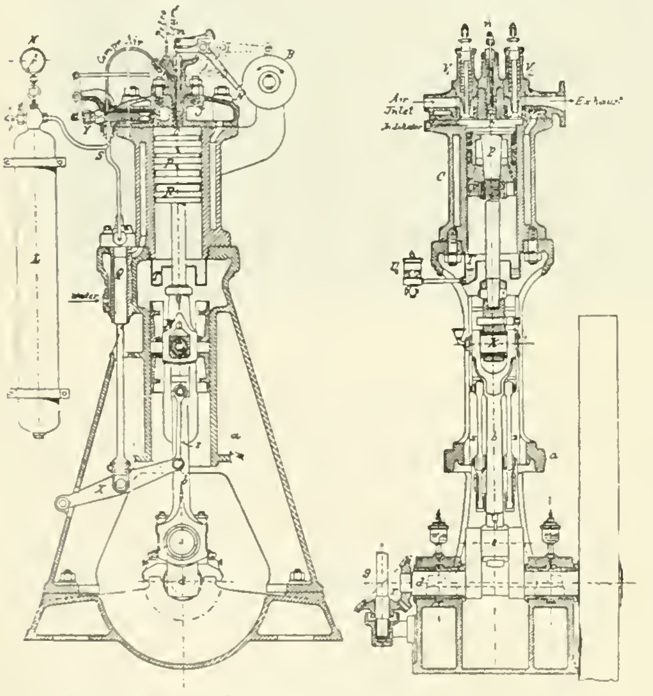
Mr. Wm. Fowden, of Camden, N. J., gives the following plan for preventing arc lamps from freezing: Take a number of thin sheets of cardboard and punch a hole in them the same size as the carbon, and if the trimmer thinks that things are going to freeze, slip one of these small pieces of cardboard on the upper carbon of the early side of the lamp. This will act as a shed for the water, and prevent the lamp from freezing.

THE DIESEL HEAT MOTOR.

An invention which is attracting considerable attention throughout the United States and Europe is the Diesel heat motor, the tests of which have shown remarkable results in the way of converting the whole heat contained in the fuel into actual work. In a paper read at a meeting of the Deutscher Ingenieure Verien, the inventor, R. Diesel, of Munich, describes the principles of the apparatus, from which we obtain the following particulars :

Mr. Diesel states that in every process of combustion two kinds of temperatures are to be distinguished : 1. The temperature of ignition ; 2. The temperature of combustion. The temperature of ignition is that temperature to which a fuel must be heated to ignite it in presence of air. The temperature of combustion is that temperature subsequently generated by the chemical process of combustion after ignition has taken place. The combustion temperature must be generated not by the combustion and during the same, but before and independent of it after ignition has taken place, by mechanical compression of pure air. To deviate from the perfect process, directly compress the air adiabatically instead of first isothermally from 2 to 4 atmospheres and then adiabatically to the 30 or 40 fold. By so doing one realizes the first of the required conditions, i.e., the generation of the combustion temperature by mere compression with pressures which are two and four times lower than those used in performing the perfect cycle.

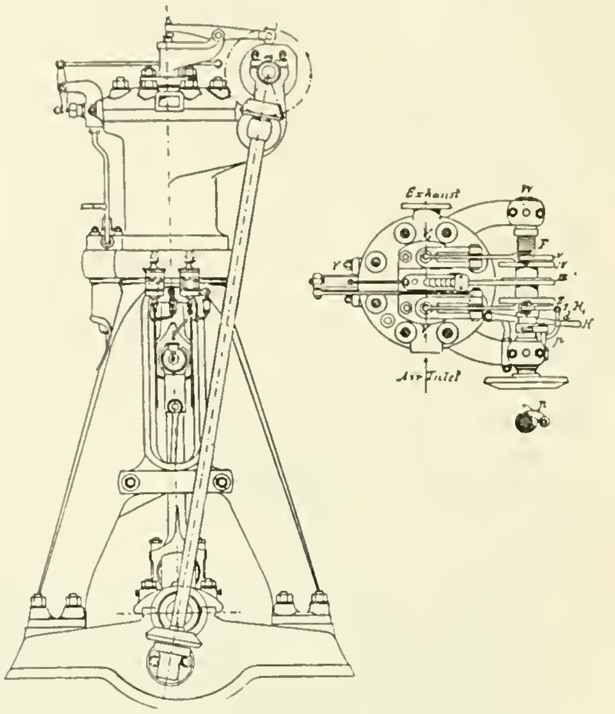
The fuel must be introduced gradually into the air, which is compressed adiabatically to the combustion temperature in such a manner that the heat generated by gradual combustion is absorbed in the so-called nascent state, in consequence of a corresponding expansion, i.e., by mechanically cooling off the gases so that the period of combustion is going on constantly isothermally. It is evident that the fuel, in order to fulfil that condition, must be charged in its physical composition to a gaseous, liquid or powdery form. That is to say, that through the combustion and during the same, no, or a relatively small, increase of temperature is caused, an idea which seems to be absurd after having heretofore always effected the increase in temperature by the combustion and during the same.



FIGS. 1 AND 2.—CROSS SECTIONS OF DIESEL RATIONAL HEAT MOTOR.

The fourth condition also presents a revolution of ideas hitherto considered correct, according to which the combustion had to be carried on with as little surplus of air as possible, while he contends that a considerable surplus of air, whose amount can be determined theoretically in each special case, is necessary.

The operation of the motor may be briefly described as follows : An auxiliary air pump compresses the air to about 500 pounds per square inch, storing it in a separate reservoir, from which it is led into the cylinder along with the oil or gas or coal-dust, and compressed still further, the temperature due to compression rising to the ignition temperature of the combustible. The fuel begins to burn and generates still higher temperature and pressure by doing so ; at the end of the stroke the consumed gases, still at a high temperature, are led into a larger low pressure cylinder, which brings the pressure down so low that the succeeding exhaust is comparatively quiet.



FIGS. 3 AND 4.—SIDE VIEW AND PLAN OF VALVES, DIESEL RATIONAL HEAT MOTOR.

In such an engine there are great possible advantages of superiority over the steam engine. No steam boiler is used ; there is, therefore, no loss of heat in the flue gases or by boiler radiation, nor steam pipe condensation. The maximum available theoretical efficiency for such a motor is greater than that of the steam engine, owing to the possibility of using higher pressures, and consequently a higher range of temperature. This theoretical efficiency varies from 50 to 70 per cent. There is no cylinder condensation, and several other sources of loss are abolished. The mechanical efficiency is, however, likely to be a little lower than that of the steam engine, owing to the high compression necessary and consequent transmission and retransmission of energy between the piston and the fly-wheel.

The experimental engines so far constructed have been of the single-cylinder four-cycle single-acting vertical type, one of which of 20 horse power was tested with petroleum in the early part of 1897. This engine is provided with a ring piston and separate cross head, water jacketed and provided with poppet valves operated by cams for admission and exhaust. A small pump is attached which keeps an auxiliary vessel filled with air compressed to a higher pressure than that obtained in the cylinder. This serves to inject the fuel, and also to start the engine.

With this engine of 20 horse power working with refined liquid petroleum, the maximum available theoretical efficiency was about 50 per cent., and the actual ratio of indicated energy to the total energy of the fuel was about 35 to 40 per cent., showing an indicated efficiency of the engine as such of 70 to 80 per cent. The mechanical losses of this engine varied between 25 and 30 per cent. on high loads, giving over 26 per cent. of the total heat of the fuel as available energy at the shaft. With reduced loads the mechanical efficiency, of course, falls off, but the thermal efficiency, owing to the greater expansion, increases, thereby counterbalancing to a large extent the other and rendering the consumption of fuel per horse power low at all but the lightest loads. Owing to the high pressure employed in this engine also, the cylinder dimensions are from 30 to 50 per cent. less than those of gas engines of the explosion type.

The governing of the speed is also as simple and easy as that of the steam engine. The exhaust gases are noticeably invisible and nearly odorless during ordinary running, owing to the perfect combustion, which also prevents fouling of the interior of the engine.

In a paper read before the same meeting by Professor Schroter, describing the tests made with the engine, the following facts were shown :

There was a noticeably exact regulation of the combustion process. One hundred and more diagrams were found to coincide exactly as with steam engines on constant load. The ratio of indicated work on compression to that of indicated work on expansion, average values for full and half load being taken, showed a value of about 50 per cent. The mean effective pressure in the working cylinder was about $7\frac{1}{2}$ kilograms per square centimetre on full load and $5\frac{1}{4}$ on half load, corresponding to 100 and 70 pounds per square inch. The effective work was measured by a modified prony break. The mechanical efficiency, that is, the ratio of effective work to indicated work, varied from 75 per cent. to about 58 per cent., as the work was varied from full to half load. The consumption of petroleum per break horse power was about 0.24 kilogram on full load and 0.28 on half load. Careful tests were made of the calorific value of this fuel, showing that there was converted into brake horse power over 25 per cent. of the available energy of the fuel at full load and over 22 per cent. at half load.

The Diesel motor has been patented in all countries where patents are granted for inventions, and the rights for the United States and Canada have been acquired by a company since incorporated under the laws of New York State as the "Diesel Motor Company of America," with offices at No. 11 Broadway, New York.

AMALGAMATION OF ELECTRICAL INTERESTS.

WITHIN the past month the amalgamation of the Thompson Electric Co., of Hamilton, and the Toronto Electric Motor Co., of Toronto, has taken place. The new concern will be known as the Toronto Electric Motor Co., Limited, with headquarters in Toronto, and a capital of $50,000. A new factory building, 95 by 50 feet, is now being erected on Pearl street, which will be equipped with modern tools for manufacturing and appliances for fully testing the finished product. A travelling crane will extend the whole length of the shop, and each machine will be connected with a separate motor, making a thoroughly complete establishment. The manufacture of arc and incandescent lighting and power plants will be continued.

CANADIAN ELECTRICAL ASSOCIATION.

A WELL attended meeting of the Executive Committee of the above association was held at the office of the secretary, Mr. C. H. Mortimer, Confederation Life Building, Toronto, on the 5th inst., to further arrangements for the annual convention which is to be held in Montreal.

The dates chosen for the convention are Tuesday, Wednesday and Thursday, the 28th, 29th and 30th of June. The headquarters of the association during the convention will be at the Windsor Hotel, where the business sessions and the annual banquet will also be held.

The draft programme recommended by the local committee of arrangements, with some slight amendments, was adopted, and is as follows :

FIRST DAY.—Executive meeting 9.30 to 10 a.m.; session, 10 a.m. to 1 p.m.; session, 2 to 5 p.m.; 7.30 p.m., trip around Mount Royal by special Park and Island cars, afterwards ascending Incline railway to lookout on mountain to view the city under illumination.

SECOND DAY.—Session, 9 to 12, noon; cabs and busses from Windsor Hotel at 1 p.m. to visit : (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Co., returning to city at 7.30 p.m.; 9 p.m., annual banquet of Association at Windsor Hotel.

THIRD DAY.—Session, 9 to 12 a.m., election of officers and visit to McGill University; 1.30 p.m., visit to Royal Electric Company's lighting station and factory, then by special G. T. train to visit the works of the Chambly Manufacturing Company at Chambly.

A number of very interesting and instructive papers relating to various phases of electrical work have been promised, and are in course of preparation.

Negotiations are in progress with the object of securing special transportation rates to enable a large number of the western members to participate in the proceedings of what will undoubtedly be a very pleasurable and instructive occasion. We hope to be in a position to announce further particulars in our May number.

PROPOSED MARITIME ELECTRICAL ASSOCIATION.

A MEETING has been called at the Halifax Hotel, Halifax, Nova Scotia, for Tuesday, the 12th inst., for the purpose of organizing a Maritime Electrical Association. The preliminary circular states that "while it is felt that all those engaged in the electrical business in Canada should, if possible, belong to the Canadian Electrical Association, there still remains a great need for an association of a more local character, whose place of meeting would be accessible to all its members, and which could discuss not only papers of a technical character, but also the questions arising from purely local circumstances." Among the principal promoters of the new organization are : Mr. E. T. Freeman, of the General Electric Co., Halifax; Mr. Jas. Waddell, P. E. I. Electric Co., Charlottetown, P.E.I.; Mr. F. A. Bowman, New Glasgow Electric Co., and Mr. J. H. Winfield, Nova Scotia Telephone Co., New Glasgow, N. S.

ROYAL ELECTRIC ENGINEERING SOCIETY.

AT a meeting of the Royal Electric Engineering Society held on March 17th, Mr. K. B. Thornton, of the Royal Electric Co., read a paper on "Alternating Current Arc Lamps," and at a meeting held on March 31st Mr. W. F. McLaren and Mr. R. F. Morkill read a paper on "Alternating Current Motors." Mr. Dix will read a paper at the next meeting on April 14th. The society are holding their meetings in the Board room at the Royal Electric Company's general offices, Queen street.

Messrs. Ness, McLaren & Bate, telephone manufacturers of Montreal, who were recently burnt out at No. 749 Craig street, have taken new premises at No. 419 St. James street (corner of Craig), and have put in a complete new plant of special tools and machinery for the rapid turning out of telephones, telegraph instruments and electricial supplies of all kinds, and they now have one of the best equipped and up to-date factories in Canada.

MATTERS AFFECTING THE COST OF ELECTRIC POWER.

By H. P. [illegible], B.A. Sc., Lecturer Toronto Technical School.

THE paper, of which the following is a short digest, was written with the intention of pointing out the nature of and relation between the various items that enter into the cost of production of electric power for incandescent lighting, and the effect upon the cost per unit output, of different styles of engines, differences in the cost of coal, and different methods of supply. It may also serve to show why the efficiency of production is lower and the cost higher than for most other forms of power. The chief thing, however, to which attention is called is the great influence of the variable load upon the cost, being much greater than poor engines or high-priced coal.

A problem of this nature cannot be attacked in a general manner, but a particular case must be taken, and results will be obtained which indicate to a greater or less extent what to expect in general practice.

A 350 K.W. dynamo used to supply power for incandescent lights in a city from 30,000 to 60,000 inhabitants will be used as the basis of calculation. This dynamo is assumed (upon information furnished by the Canadian General Electric Co.) to have at an output of 336 K.W., a commercial efficiency of 93.8 %. Its efficiency curve is given, No. 17, Plate II.

In order to get the total capital invested we have to figure on boilers erected and connected, engines ready for work, dynamo, including switchboard and all necessary instruments, etc., building chimney and ground, and then allow an additional amount for inspection and loss of interest during construction. Figures are given by Dr. Chas. Emery, of New York, which represent good modern practice for engines and boilers, both in regard to cost and efficiency. These figures, which are given in the report of the proceedings of the A.I.E.E., are used in the present paper to arrive at the capital invested in engines and boilers. Good modern water-tube boilers are used, at a cost of from $22 to $25 per H.P., set up and connected. The horse power required in each case is calculated from the assumed steam consumption of the engine. Four styles of these are used:

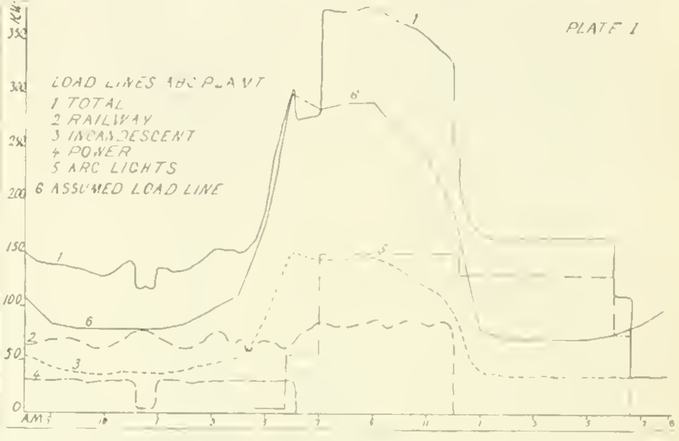
1. Simple high-speed non-condensing.
2. Simple low-speed non-condensing.
3. Compound high-speed condensing.
4. Compound low-speed condensing.

The coal is to have an evaporative power of 8.5 pounds of water, and assuming a four per cent. loss in the belts and a dynamo efficiency of 93.8 per cent., the output in watt hours per pound of coal at full load given in column 39 is obtained.

The interest or dividend to be paid, which comes into the cost account, is placed at 10% on the capital invested. The remaining expenses may be included under: Depreciation on boilers, engines, dynamo and buildings; supplies and probable repairs; wages, insurance, taxes, renewals and cost of coal. Calculation is made with each of the above styles of engine for coal at $2.67 and $4.46 per ton of 2,000 lbs., and for the three cases: first, where the plant runs fully loaded for 308 days of 10 hours each; second, for 365 days of 20 hours each; and third, where the power has to be supplied according to the load line, No. 6, on plate I. It will be noticed that in this case there is the same total output per day as when the plant was fully loaded for 10 hours, that is, 3,360 K.W. hours.

There is not space in the present condensed article to describe and justify the methods used in arriving at the cost in this third case, more than to say that such expenses as wages, renewals, repairs, interest and taxes, will be as high for a year as if the plant ran fully loaded. The cost per unit output is therefore increased. The cost of coal per unit output is obtained by plotting an efficiency curve for the plant, showing the output per pound of coal at various loads. This is done in the case of engine No. 4 only, but in order to compare the total costs in each case, the same efficiency curve is used with the others.

The curve of engine efficiency, No. 16, is plotted in the following way: The decrease in efficiency due to increased cylinder condensation is calculated, using a method given by Professor Carpenter for this style of engine. It is a modified form of Thurston's proposition that the wastes vary as the square root of the number of expansions, and seems to give results comparable with those obtained by actual experiment. For the friction there is 56 H.P. lost at full load. This includes both engine and jack-shaft friction. Of this, 40 H.P. is assumed to be a constant for all loads, and the remaining 16 H.P. is a function of the I H.P. Having by this means obtained curve No. 16, it is easy to obtain No. 18, which gives the engine efficiency in terms of the dynamo output. Combining 18 and 19, we get No. 20, which gives the efficiency of the plant in per cent. of that at full load. Taking this curve in conjunction with the assumed load line, No. 6 on Plate I, the average cost of coal per K.W. hour is found, and then the total costs as given in columns Nos. 33 and 34.



To give an idea of the nature of the costs of distribution to consumers columns 35, 36, 37 and 38 are calculated. Suppose the generator is wound for 111.3 volts, and there is an average drop of 5% on the lines, the average voltage supplied will be 106. The 336 K.W., at a pressure of 111.3 volts, will mean 3018 amperes. A loss of 18 amperes is assumed through the shunts of the Thompson meters and other leakages. This leaves 3000 am-

TABLE OF COSTS.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
No. of Engine.	Horse Power.		Cost of Coal per h.p. per Yr.				Capital invested per h.p.						Interest on Capital, 10% on Col. No. 12.	Depreciation on				Cost per net h.p. per year of				
	I h.p. of Eng.	Commercial of Boilers.	On basis of 308 days of 10 hrs. each. Cost of Coal per ton.		On basis of 365 days of 20 hrs. each.—Cost of Coal per ton.		Boilers er'c'd & c'n't'd, $22 to $25 per h.p.	Eng's er'c'd and ready for work.	Dynamo, incl'd'g Sw'ch-board, &c.	Buildings and Chimneys.	Total.	Total + 2½% for inspect'n and 6% for loss of int'r't dur'g const'n		Boilers at 7%.	Engines at 4%.	Dynamo at 3%.	Buildings at 2%.	Supplies and Pro'ble R'p'rs on basis of		Wages on basis of		Insur., 0.5%, Taxes, 1.2%, Renewals, 3.3%.
			$2.67	$4.46	$2.67	$4.46												308 dys. of 10 hrs.	365 dys of 20 hrs.	308 dys. of 10 hrs.	365 dys. of 20 hrs	
			$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$	$
1	542	596	19.09	31.82	43.20	72.00	26.22	17.50	17.50	19.18	80.40	87.23	8.72	1.83	0.70	0.52	0.38	2.98	7.05	6.01	14.26	4.02
2	556	537	17.22	28.69	38.95	64.92	23.63	25.00	17.50	18.72	84.85	92.06	9.21	1.65	1.00	0.52	0.37	2.55	6.03	5.72	13.57	4.24
3	542	361	11.57	19.79	26.18	43.64	15.88	24.50	17.50	14.86	72.74	78.92	7.89	1.11	0.98	0.52	0.30	2.98	7.05	4.86	11.57	3.64
4	556	334	10.69	19.29	24.18	40.30	14.70	30.00	17.50	14.92	77.12	83.67	8.37	1.03	1.20	0.52	0.30	2.55	6.03	4.72	11.20	3.86

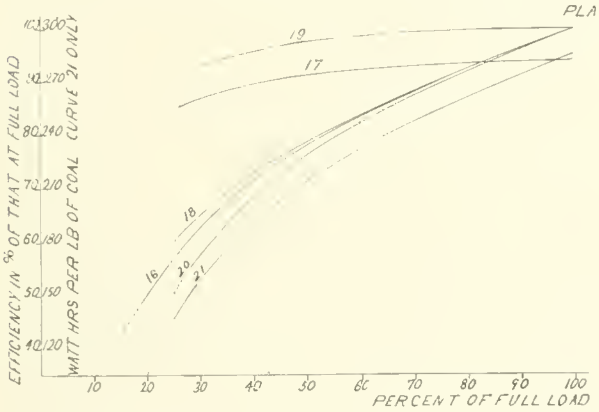
	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39
No. of Engine.	Total of all Expenses but Coal on basis of 308 days of 10 hours.	Total of all Expenses but Coal on basis of 365 days of 20 hours.	Total cost per net h.p. per year.				Total cost per k.w. hour at Switch-board.						Total cost per k.w. hour delivered to Consumers, taking into account the loss in and the cost of distribution.				Watt hours per lb. of Coal, not counting coal wasted.
			On basis of 308 days of 10 hours. Cost of Coal per ton.		On basis of 365 days of 20 hours Cost of Coal per ton.		On basis of 308 days of 10 hours. Cost of Coal per ton.		On basis of 365 days of 20 hours. Cost of Coal per ton.		Assuming a load line. No. 6. Plate 1.		On basis of 308 days of 10 hours. Cost of Coal per ton.		On basis of 365 days of 24 hours. Cost of Coal per ton.		
			$2.67	$4.46	$2.67	$4.46	$2.67	$4.46	$2.67	$4.46	$2.67	$4.46	$2.67	$4.46	$2.67	$4.46	
	$	$	$	$	$	$	cents.	cents.	cents.	cents.	cents.	cents.	cents.	cents	cents.	cents.	
1	25.16	37.48	44.25	56.98	80.68	109.48	2.138	2.757	1.645	2.232	3.018	3.876	2.917	3.571	2.016	2.637	159.7
2	25.26	36.59	42.48	53.95	75.54	101.51	2.053	2.607	1.540	2.069	2.762	3.609	2.827	3.412	1.905	2.464	177.1
3	22.28	33.01	33.85	42.07	59.19	76.65	1.636	2.032	1.207	1.562	2.199	2.769	2.386	2.805	1.553	1.928	263.5
4	22.55	32.51	33.24	41.84	56.69	72.81	1.606	2.022	1.156	1.484	2.113	2.639	2.355	2.794	1.499	1.845	285.4

peres at a pressure of 106 volts, or 318 K.W. supplied to customers. For an installation of this size in a city where the consumers do their own inside wiring and the line work is all above ground, the estimated cost of the construction work is placed at $40,000. This provides for 6,000 60 watt lamps, and the estimation is made on figures obtained from one of the agents of the Canadian General Electric Company. The following items will have to be added to the cost account :

Interest on $40,000 at 10%..........................	$4,000
Depreciation on construction work at 4%..........	1,600
Salary of clerk to keep books and render accounts, etc., at $12 per week..........................	624
Wages of boy to read meters, etc., at $4 per week...	208
Total.......... ..	$6,432

This means that without taking into account the loss in distribution, 0.657 cents will have to be added to the cost per K.W. hour on the basis of 308 days of 10 hours, and 0.277 cents will have to be added in the case where the plant runs 365 days of 20 hours. Taking into account the loss in distribution, the total costs per K.W. hour as given in columns 35, 36, 37 and 38 are obtained.

Upon looking over the official reports of pumping engine tests, it is seen that the work actually done per pound of coal is in many cases equivalent to 400, 500, or even more watt hours, whereas in power houses the output is in many cases less than 100 and seldom over 200 watt hours per pound. This is notwithstanding the fact that an engine and dynamo can be constructed nearly, if not actually, as efficient as a pumping engine. The low efficiency is due directly and indirectly to the variable load, which has a still greater effect on the cost of production. It lowers the efficiency directly, as already pointed out in the preceding calculation. Moreover, if an attempt to keep up the efficiency is made by dividing the units, it is still much lower than it would be with a constant load. The units must be smaller and, therefore, less efficient, and besides this there are extra belting and friction losses introduced. The total load line in most power houses will be made up of a number of different kinds of load lines. Curves 1, 2, 3, 4 and 5, on Plate I, are taken from a power house in a city having between thirty and forty thousand inhabitants, and illustrate what is meant. Different sizes and styles of units will have to be installed, and this results in a much lower efficiency than could be otherwise obtained. The engines used in the calculations represent good modern practice for this size and style, yet with these even at full load it can be seen that the efficiency is comparatively low, and with the load line assumed, which is equivalent to a load factor of 46, the efficiency has been reduced to 62.5% of that at full load.



The effect of the variable load upon the cost is even greater. The items which enter into the cost account may be classified as follows :

First : Those that vary directly as the output. The cost per unit is the same no matter what the load. This class includes such items as cost of carbons and incandescent lamp renewals.

Second : Those that decrease with the output, but not so rapidly. The cost per unit increases to a great or or less extent. This class includes cost of coal, oil, supplies of certain kinds, and perhaps wages.

Third : Those that remain constant no matter what the output. The cost per unit varies inversely as the output. This includes insurance, taxes, rent, interest and generally wages.

It is evident, then, that as the two latter classes include the greater part of the costs, the cost per unit must greatly increase as the load factor becomes smaller.

MUNICIPAL OWNERSHIP VS. PRIVATE CORPORATIONS.

Mr. M. J. Francisco, of Rutland, Vermont, has issued the fifth edition of his work entitled "Municipal Ownership vs. Private Corporations," in which he presents many strong arguments against municipal control of electric light plants. Mr. Francisco commenced the investigation of municipal ownership in 1885, and has personally visited nearly all the municipal plants in the United States and Europe. Having had many years' experience in the electric light business he is in a position to analyze statements made in regard to the management of plants, and to judge of their efficiency.

At the outset the author shows how many of the erroneous statements regarding the cost of electric light produced under civic control are arrived at, and refers at some length to municipal ownership in England and Scotland, where the actual facts prove it to be much less successful than is generally supposed.

Some figures submitted by Mr. Francisco are interesting. Statistics from 174 private companies show the cost per lamp per hour to be .0252 cents, while they furnish on an average 654 candle power per hour for one cent. The same analysis of 86 municipal lighting plants, taken from every state in the United States in which municipal plants are operated, shows that the average cost per hour is .0359 cents, while they only furnish on an average 404 candle power per hour for one cent. This shows that the private companies are furnishing the lights on contract on an average of .107 cents per hour less than the municipalities can produce them, and also furnishing 250 candle power per hour more for one cent than the municipal plants. Late reports from municipal plants also show that the expense of maintaining the plant is increasing each year, but notwithstanding this increased cost in municipal plants, the price charged by private companies for lights has decreased every year. A list is published of municipal plants that proved unsatisfactory, and were abandoned or sold.

Massachusetts, it is stated, has a commission which controls the electric companies, and from statistics obtained from the commissioners' report, the following figures as to the average cost are obtained :

Municipal Plants in Massachusetts.	Cost per year.	Cost per hour.	Candle power per hour for 1 cent.	Hours per night.	Nights per month.	Candle power of lamp.
Braintree..........	$133 34	.0587	204	7	27	1,200
Domers..........	73 06	.05	240	6	24	1,200
Middleboro..........	107 34	.049	204	8	25	1,200
Marblehead..........	100 30	.036	333	8	29	1,200
Peabody..........	90 76	.0266	451	10	30	1,200
Reading..........	138 86	.0951	126	6	23	1,200
Wakefield..........	124 30	.0851	141	5	23	1,200
Average..........	$110 99	·04	248	7	25	1,200
Private Corporations in Massachusetts.						
Hyde Park..........	$ 66 66	.042	476	5	26	2,000
Chelsea..........	109 50	.0286	419	11	29	1,200
Boston..........	127 75	.0354	536	10	30	2,000
Springfield..........	75 00	.0208	576	10	30	1,200
Westfield..........	82 00	.0379	527	6	30	2,000
Haverhill..........	132 24	.038	526	10	30	2,000
Worcester..........	127 75	.0354	536	10	30	2,000
Average..........	$102 98	.034	513	8	29	1,771

It will be seen that the average cost per lamp per year in the municipal plants is $110.99, while the same cost with private companies is $102.98. The average cost per hour is .04 and .034 cents respectively, and the average candle power per hour furnished for one cent 248 and 513.

LONG DISTANCE TELEPHONY IN CANADA.

RAPID as has been the development in the application of electricity to the requirements of social and commercial life, in no direction has this development been more surprising than in the science of telephony, and more especially in the extension of its capabilities for long distance communication. It is doubtful if the achievements of the long distance telephone are as yet fully appreciated by many who are well versed in the triumphs of other branches of electricial science; much less to the general public. It is our appreciation of this fact that induces the conclusion that a review of the long distance telephone service of the Bell Telephone Company of Canada would be interesting, as well as instructive, to many of our readers. Comparatively few people in Canada realize that to-day it is perfectly feasible to converse satisfactorily by long distance telephone, say, from Toronto to Portland; Montreal to Pittsburg or Chicago; Hamilton to Baltimore; or Ottawa to Washington. Yet it can be, and is being done.

Leaving aside altogether the enormous and constant application of inventive skill and capital which have been required to bring the local telephone service to its present efficiency, it is certain that the changes and the development of the long distance branch of the service have been equally radical and proportionately expensive.

The first attempt of the Bell Teleephone Company of Canada to establish a long distance service, was made in 1881, by the construction of a single iron wire line between Toronto and Hamilton, then considered quite an achievement, and the line was well patronized. Within three years, 855 miles of poles and 1,500 miles of wire were constructed by the company, but so rapidly did conditions change, that even in this short time this type of line was found inadequate to the requirements of a growing business.

In 1885 copper wire was substituted for iron wire, affording better results. The introduction of the electric light and trolley, however, soon forced upon the company another and a more radical change, and metallic circuits had to be adopted upon all principal lines. This change, begun in 1885, was carried on as fast as circumstances would allow until all the principal lines of the company were made metallic, or, in other words, two wires were necessary to transmit a satisfactory converstation where one would suffice before the introduction of electric cars.

The extension of the system, in the meantime, went on apace, until, at the end of ten years, the company had in operation 4,484 miles of pole line and 13,148 miles of wire in its long distance service, and at the present time they have in the provinces of Ontario and Quebec 6,095 miles of poles, bearing 16,567 miles of wire.

Connections have been established with the extensive long distance system of the American Telegraph and Telephone Company and affiliated companies in the United States, at Newport, Vermont, St. Albans, Ogdensburg, Buffalo and Detroit, affording a system of direct telephonic communication as far south as Virginia and Tennessee, and from the cities and towns of the Atlantic seaboard westward to Nebraska.

The difference in the cost of the first long distance line of 1881 and the long distance line of to-day affords one of the serious problems in finance which the company has to meet. It is not a mere matter of change; it is a revolution requiring absolutely new and far more expensive construction. In 1881 a No. 9 iron wire (288 lbs. to the mile) was the best in use. To-day most of the construction is of two copper wires (which together weigh 532 lbs. to the mile). Formerly 32 poles to the mile were sufficient, but with the introduction of copper, in order to reduce the strain upon the wire, 40 poles to the mile are used; the poles have to be set deeper in the ground and more carefully stayed, all of which greatly increases the cost.

The long distance central office equipment of to-day is much more expensive than it was ten years ago, improvements having been made to facilitate the work of operating and to secure the best results in communications. The astonishing results which the long distance telephone service of to-day affords is due as much to the improvement in instruments, switches and other apparatus, and to the system upon which these are employed, as it is to the improvement in the lines.

Many people suppose that the long distance telephone is a competitor of the telegraph, and they are unable to understand the cause of the difference in rates. The competition is largely, if not entirely, mythical, and the reason for difference in rates is easily explained. The telegraph employs a single iron wire conductor, and, by means of a quadruplex instrument, this single wire is made to serve the purpose of four wires. The long distance telephone service requires two copper wires for each circuit, which together weigh nearly double what the single iron wire does, and costs over five times as much per pound. The general construction and office equipment of the long distance telephone service is also far more expensive than that of the telegraph. Nor does the comparison end here. An ordinary ten-word telegram may be transmitted in one minute, and it is practicable to transmit four messages simultaneously over one wire. Each completed conversation over the long distance telephone occupies two wires for an average of ten minutes; the comparison, therefore, being two copper wires for ten minutes, as against one-quarter of a single iron wire one minute.

Another important difference arises from the essential difference in the two systems of communication. The sender of a telegram writes out his message and goes about his business, and the operator forwards it as other demands on the line will best admit, with slight reference to time, thus keeping the telegraph lines fully employed at all hours.

The correspondent by telephone must have the line when he requires it, or not at all, and practically the entire earnings of the long distance telephone line must be within such hours as business men generally are in their offices, the hours during which these lines are productive being thus limited; and, as has already been pointed out, the capacity of the long distance line being confined to an average of six conversations per hour, it is clear that the rate must be sufficient to yield during that time an adequate return upon the investment and expenses.

Telephone rates are based on mileage and the time the line is occupied. The parties to a conversation absolutely control the line for the whole distance between them, on the average, ten minutes (five minutes for the conversation and five minutes to arrange the connection and to disconnect the line). It follows that in equity they must pay for the investment they control for the time it is at their disposal. Therefore, distance and time must be the ruling factors in fixing the rates.

The telegraph and long distance telephone have distinct functions and serve a different purpose to the commercial world. The telephone has, in reality, created a business for itself. Time is, to-day, the prime consideration in the transaction of much business, and the long distance telephone obliterates both time and space. Retail merchants no longer carry the heavy stock of former years, but promptly supply the requirements of their customers through the connection the long distance telephone affords with the wholesaler. So, through every branch of business the telephone has become a distinct and indispensable factor, the usefulness of which will be extended as its possibilities become more generally known and recognized.

AN HISTORICAL CHAPTER ON THE STEAM ENGINE.

For the following historical chapter, which traces from B.C. down to the present time, in chronological order, the different stages the steam engine has gone through to make it what it is to-day, we are indebted to a treatise entitled "Smokeless Heat," issued by the General Engineering Company, of Toronto :

927 B.C.—Homer spoke of steam as we do.

390 B.C.—Plato described steam as water melted into air by heat, which could be compressed into water again.

222 B.C.—Archimedes is said to have used steam in his defensive engines.

150 B.C.—Hero is associated with the invention of the steam engine, although it appears to have been known 1,000 years before his time. He invented hot air, rotatory and idolatrous engines.

1543.—DeGary, a Spanish captain, proposed to propel ships by steam.

1601.—Porta, the inventor of the magic lantern, showed the relative volume and force of steam in raising water.

1612.—De Caus showed the power of the sun on confined water by lenses ; to increase the sun's effect, water was forced up six feet in pipes.

1618—David Ramsay obtained a patent for an engine to plough without horses, to raise water and propel ships and to raise water by fire from deep pits, move ships against wind and tide, and to fertilize the earth.

1629.—Branca describes a rotary steam engine he used for grinding drugs.

1648.—The suggestion of flying by high pressure steam and large wings was made.

1651.—Marquis of Worcester pumped water by steam engine.

1702.—Savary states, "My engine raises a full bore of water sixty or seventy feet high, and if strong enough I would raise water 500 to 1,000 feet high." Savary was the first to use guage cocks. It is related that Savary accidentally discovered the force of condensation of steam from a wine flask—not quite empty—being thrown on a fire and producing steam. He took it off the fire and immersed its mouth below cold water, which condensed the steam and filled the flask by atmospheric pressure.

1705.—Newcomen employed the air to perform the work of pumping water and steam only used as an auxiliary. Newcomen, by condensing the steam below the piston, forced it and that end of the beam down, whilst the elevation of the other end raised water from the mine. Steam was therefore used merely to raise the piston, and air to do the work.

1740.—Experiments made at Newcastle are said to have realized an evaporation of eight pounds water for one pound coal.

1757.—Fitzgerald added the fly-wheel to the engine.

1762.—Dr. Black investigated the properties of heat and steam and propounded the doctrines of latent heat.

1766.—Blakely introduced tubular boilers.

1770.—Cugnot, French engineer, made a model of a steam locomotive, and the French government constructed one at the Pasis arsenal and tried it in 1771, and then "laid it aside."

1772.—Smeaton determined the relative steaming values of different coals. Smeaton realized a duty of 112,500 foot pounds for one pound coal.

1730-1819.—The great defect of Newcomen's engine as improved by Smeaton was the loss of heat arising from condensing the steam in the working cylinder. James Watt estimated this to be nearly 35%, and in

1769.—Watt patented the addition of a separate condenser.

1782.—Watt invented the double acting cylinder, using steam on both sides ef the piston.

1799.—Watt's assistant, Murdock, introduced the eccentric and slide valves. Watt invented the governor and throttle valve. To overcome a patent unfairly obtained through one of his workmen, Watt invented and used the

1780.—Sun and planet wheels in place of the crank. Watt claimed the crank was part of his design, but to avoid litigation used this arrangement.

1776.—Watt introduced the expansion of steam. He calculated when cut off at half stroke the performance would be as 1.7, at ¼ stroke as 2.4, and at 1/7 as 3 in economy as compared with steaming the whole stroke. Watt was the first to recognize fully the importance of gaining some knowledge of the action of steam in the cylinder, and the first form of an indicator was the result of his efforts.

1776.—Bushnell proposed a screw propeller for ships.

1778.—Watt erected at Shadwick waterworks, an engine, working expansively.

1780.—Watt, by improved flue and other arrangements, obtained 8.6 pounds evaporated water per pound coal, or nearly 10% better than Smeaton.

1781.—Hornblower patented the same principle, expanding the steam into a second cylinder which led

1782.—Watt to patent his single cylinder plan of expansion. It cost Boulton, Watt's partner, $400,000 to defend his patent rights and introduce his engines before any profit was realized.

1784. James Rumsy exhibited on the Potomac a boat propelled by machinery. He exhibited a boat in which a pump worked by steam power drove a stream of water from the stern and thus furnished the motive power.

1786.—Symington tried to combine Newcomen's atmospheric engine with Watt's separate condenser, yet evade the patent, but failed to do so. Symington constructed the first paddle wheel steamboat of the modern class.

1791.—Street dropped turpentine on hot iron and exploded the vapour formed below a piston to produce motion.

1797.—Cartwright used metallic packing.

1790-1816.—Trevethick erected in connection with Watt's former workman, Bull, several engines with double-acting cylinders. This able engineer introduced high pressure steam and expanding to a low pressure. So marked was the economy that the Court of Spain sent him with regal honors to the silver mines in Peru to drain them.

1800.—Bell fitted a four horse power engine in a small vessel and sailed from the Clyde to the Thames at seven miles an hour.

1802.—Trevethick patented a road locomotive which was successfully tried near London.

1804.—Improving on this he completed a locomotive to draw coal. It worked well, drawing ten tons of iron at five miles an hour. Trevethick was the inventor of the first modern locomotive.

1804.—Oliver Evans showed wonderful grasp of the science, but for want of money he could not carry out his ideas. He used the exhaust steam to heat the feed water ; he worked with high pressure steam. In the writer's opinion Evans has not got the credit he deserves.

1804.—Stevens, of Hoboken, with a Watts engine 4½ x 9, supplied with steam from a boiler consisting of eighty-one horizontal copper tubes one inch diameter and two feet long, propelled a steamboat four miles an hour by a screw.

1793-1807.—Fulton successfully introduced steam boilers on the Hudson.

1815.—Ralph Dodd put a fourteen h. p. engine into a seventy-five ton boat and made a trip of 758 miles in 122 hours in very stormy weather.

1807.—M. DeRevax moved a locomotive carriage by exploding a mixture of hydrogen and air in a cylinder by electricity.

1813.—Blackett demonstrated that the enormous weight of the adhesion between the smooth rails and the equally smooth wheels would suffice to prevent the wheels of a locomotive from slipping.

1814.—George Stephenson ran his locomotive "Blucher" on the Killingworth railway.

1818.—Napier successfully prosecuted steam navigation and in

1822.—The "James Watt," of 100 h. p. and 440 tons burden, ran from Leith to London at ten miles per hour.

1824.—Brunel tried a carbonic acid gas engine.

1829.—Stephenson obtained the prize of £500 for constructing and running his locomotive "Rocket" over a distance of thirty miles in two hours and seven minutes. This test was between the "Sanspareil" built by Hackworth, and the "Novelty" built by Ericsson, and was to be a run of thirty miles at not less than ten miles per hour backward and forward along a mile level, with a load three times the weight of the engine. The "Novelty" after running twice along the level was withdrawn, owing to the failure of the boiler plates. The "Sanspareil traversed eight times at a speed of nearly fifteen miles an hour and was stopped owing to the machinery being deranged. The "Rocket" was the only one to stand the test. The maximum speed was twenty-nine miles per hour and the minimum twelve. Stephenson made a splendid reputation, and projectors of all kinds, together with young men, asked his advice and counsel. This he gave cheerfully, except when these youths were "affectedly dressed," and put on "airs" contrary to his notions of propriety. To one youth applicant of this stamp he said : "I hope you will excuse me, I am a plain spoken person, and am sorry to see a nice-looking and rather clever young man like you disfigured with that fine patterned waist-coat and all these chains and fang-dangs. If I had bothered my head with such things when at your age I should not be where I am now."

1829.—Ericsson introduced hot air as a competitor with steam.

From 1829 until the present date the history of the locomotive is a vast series of improvements in details, far too various and numerous to mention here, until now it is one of the most perfect and beautiful of all the machines with which the engineer has to deal, and of which he is justly proud.

CORRESPONDENCE

CONVERSION OF WAVE FORCE INTO MECHANICAL FORCE.

CALGARY, N.W.T., March 4th, 1898.

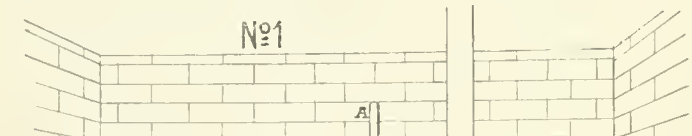
To the Editor of the CANADIAN ELECTRICAL NEWS:

DEAR SIR,—While perusing the contents of the Toronto World of the 15th of January, 1898, I came across an article headed, "Thomas A. Edison, Jr., thinks he has a plan to harness old ocean for man's benefit. Now, sir, Thomas A. Edison, Jr., is not the only individual who has solved this problem, as I believe I have plenty of evidence to prove.

About five years ago I showed this same plan of applying wave force to mechanical appliances to Joseph Powell, an architect and civil engineer, of Hamilton, Ont., and endeavored to persuade him to start a company to finance it and take out patents, but he said that it would require such a large amount of money that he could not get anyone to take hold of it. I showed him how it could be used to generate current for the Pacific cable at the intermediate stations in the Pacific Ocean, and thereby save the shipping of coal to these stations; also that wherever a body of water existed that had any swell or roll whatever on its surface, how it could be used or applied for lighting, heating, cold storage, and other mechanical uses, and this by the very same plan as mentioned in the article in the World, viz., floats connected or rather held in position by a pier, these floats to have a lever to each one, one end of each of these levers to be connected to a float, the other end connected to either a piston, a rack or a clutch-rod, and, of course, the lever working on a fulcrum. I showed him how it could be used: first, to compress air; second, raise water to a higher plain; third, compress ammonia; fourth, with the rack or clutch-rod for direct connection with dynamic or other machinery; the first to be used in connection with air engines, the second for turbines, the third for cold storage, and the fourth as stated.

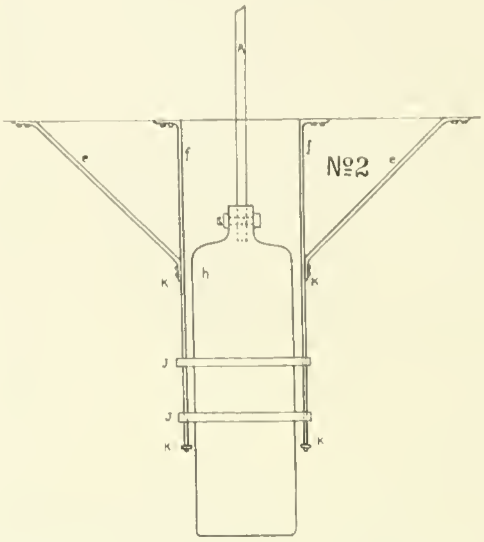
I also spoke about it to a man named Moses, who was the inventor of the "Moses" stove; he had a hardware store on Yonge street, Eglington. I approached him with reference to having tin pump cylinders made for a model, but which I did not get, as I used the clutch-rod. I also spoke to Mr. Oldfield (proprietor of the Anglo-American Novelty Co., formerly on Lombard street, then on Adelaide street east) about the same invention, and roughly described it to him one day in the Yonge St. Arcade. I also mentioned the fact that I had solved the difficulty to G. Clay, accountant, Yonge St. Arcade, and I know I have mentioned it to others.

I conceived the idea about ten years ago while watching the landing stage at Liverpool, England, where the ferry-boats run alongside and discharge their passengers. This landing-stage is thousands of tons, I believe, and is lifted up and lowered down by floats, as the tide varies.



Lastly, I wrote Thomas A. Edison about this matter near the close of the year 1896 or beginning of 1897, but I do not remember giving him any details whatever. I obtained Mr. Edison's address from Mr. Haines, the book-keeper for Matthew Bros. & Co., 48 Temperance street, Toronto, and told him I was writing Edison about an invention. I also told H. Matthews the same thing. However, Mr. Edison never acknowledged receiving my letter. Three years ago, while in charge of the North Toronto Electric Light and Waterworks, I had a model running on this same plan.

I send you tracings of my original apparatus. No. 1 gives a general idea of how the wave motion is converted by rods (of which there may be any number) A, g, into circular motion by friction between it and pulley B. The pulleys b and b^1 are simply accessories to insure, first, instant release immediately rod commences to descend, and second, a firm grip on B when ascending. As you will see, the pulley b is so inclined that by any upward movement it must press against the rod A and thereby cause it to grip the pulley B; the pulley b is held in position by arm and counterbalance c. The pulley b^1 is similarly inclined, but in opposite direction to pulley b, so that any downward movement of rod A tends to move it on its arm downwards, and in so doing throws or pushes the rod A away from pulley B. The governors act through the levers shown on the cam N in such manner that when the required speed is reached the cam presses down on the arm which supports pulley b, and prevents pressing rod A against B. Of course, it must be understood that there can be any number of rods, so as to obtain continuous and steady motion.



Tracing No. 2 is a general idea of floats, of which there may be any number, and also of any size or tons displacement. They may be braced to suit requirements. A is the rod which may transmit the motions through the other levers or direct to mechanism, as, for instance, through B to C, Fig. 1.

The bands, J, J, No. 2, are so constructed as to form runners on guides, f, f. K, K, are stops, which might be provided with spiral springs, to form a cushion and prevent a jar or shock, when the float was lifting and falling its whole capacity, but there would require a harbor to be built around the station, and if the harbor was properly constructed with gates, the "rise" and "fall" could be so modified as to always, except in calms, have the floats rise and fall about the same distance, no matter how stormy it was outside of the harbor.

In conclusion, permit me to repeat that I know this is practicable, although, like everything else, or other first ideas, it can be improved upon. I think I have an improvement myself, but a model of this one has worked, and apparently worked well. From the World's description, Edison's idea is a similar one, and no doubt, as it is connected with his great name, he will get all the honor, and the world will wonder how his brain could grasp or conceive such a "mighty" simple thing; and of course, why it is absurd that any one else could do the same.

Yours respectfully,

WM. CROSS, C.E.

Of the forty-two largest cities in Japan, from Tokio, with 1,368,000 population, down to those of 26,000, electric lighting systems are installed in twenty-four, eighteen being without electric lights.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By. Wm. Thompson.

[Article 4].

Chemical analysis of a boiler feed water not only enables the chemist to determine the quantity of foreign matter present, but also the condition or form in which it appears as an impurity; it also enables him to express with certainty an opinion as to the nature of scale that will be found and quantity that may be expected, and thus judge as to the suitability or otherwise of a water for boiler feed purposes. For purposes of illustration I have chosen a number of characteristic samples of water, all of which have, in some respects at least, different properties.

No. 1 is a sample of water from an artesian well in the eastern portion of the city of Montreal that shows an almost entire absence of lime and magnesia salts, but which is still strongly impregnated with impurities. A partial analysis shows this water to contain:

Total solids per imperial gallon	36.42	grains.
Made up as follows:		
Sodium chloride (salt)	2.32	〃
Sodium sulphate	6.85	〃
Alkaline carbonates and bicarbonates with traces of silica	27.25	〃

The whole of the foreign matter contained in this sample of water consists of soluble salts in chemical solution, that is to say, salts that have a very high degree of solubility in water, and consequently precipitation of impurities as scale-forming agents cannot occur. Although this is positively a non scale-forming water, it cannot be classed as a good or even fair water for boiler feed purposes in its original form. A glance at its composition shows it to be strongly alkaline and liable to cut the boiler and boiler fittings. As a matter of fact this is what occurred in actual practice, and users found it impossible to use the water satisfactorily until impurities had been neutralized by chemical treatment.

No. 2 is a sample of water from an artesian well used to supply the town of Montreal West, and may he classed as a fair boiler feed water. As will be seen, this water is very rich in dissolved solids, and also contains a fair percentage of scale-forming material. Partial analysis shows it to contain:

Total solids per imperial gallon	96.2	grains.
Made up as follows:		
Insoluble suspended matter	1.00	〃
Aluminia and peroxide of iron	.20	〃
Carbonate of lime	5.20	〃
〃 〃 magnesia	3.17	〃
Sulphate of soda	13.49	〃
Chloride of soda	60.60	〃
Alkaline carbonates and bicarbonates	12.54	〃

Here we have an example of water that actually contains scale-forming agents and at same time material necessary to prevent formation into hard scale when precipitated. This water showed in use results that might be anticipated from its composition, precipitating a heavy insoluble sludge at lowest part of boiler, and after boiler had been in use a short time water became both highly concentrated and strongly alkaline, although the boiler was only evaporating about 700 gallons of water per day; a sample of water drawn from the boiler three weeks after being put in use, analysis showed it to contain an enormous amount of dissolved solids held in solution, composition of impurities being as follows:

Total solids per imperial gallon	2796.36	grains.
Insoluble suspended matter	6.72	〃
Chloride of soda	1940.40	〃
Sulphate of soda	425.28	〃
Alkaline carbonates and bicarbonates	398.48	〃
Hygroscopic water	25.48	〃

So strongly alkaline had the water become that brass fittings on boiler were being attacked, and wherever a small leak occurred deposits formed on outside of boiler, which is a marked characteristic of the behaviour of the soda salts. At no time, however, during the last four years has any scale been found, a heavy sludge precipitating, having the following composition:

Silica	6.44%
Alumina and peroxide of iron	16.32%
Carbonate of lime	54.92%
〃 〃 magnesia	7.40%
Sulphate of soda	2.37%
Chloride of soda	10.80%
Carbonates of soda and potass	1.25%

The presence of the soluble soda salts in the sludge may be explained by remarking that the sludge was of such a consistency that a quantity of water had to be withdrawn at all times with the sludge. Until the composition of impurities contained within this water was known a great deal of difficulty was experienced in its use, particularly by foaming. The only treatment required, however, is to keep the water within the boiler from becoming too concentrated by frequent blowing off, and good results are now being obtained from its use.

Samples 1 and 2 mark distinct classes of feed waters. In No. 3 we have a sample of water of another type, an excellent water for boiler feed purposes and used largely by both the Grand Trunk and Canadian Pacific railway companies, for use in the boilers of their locomotives. This sample was obtained from Brampton, Ont., and is supplied to the town by means of gravitation from a small lake situate a few miles north of the town. Analysis show it to contain but a small quantity of dissolved solids and to be remarkably free from lime and magnesia salts, composition of impurities being:

Total solids per imperial gallon	6.00	grains.
Insoluble suspended matter	.40	〃
Carbonate of lime	2.85	〃
〃 〃 magnesia	.30	〃
Chloride of soda	1.20	〃
Sulphate of soda	.48	〃
Alumina and peroxide of iron (traces)		

This is a type of feed water that tends to make engineers happy and requires but occasional washing out to dispense with either chemical or mechanical treatment.

Samples No. 4, 5 and 6 show examples of scale-forming waters in various forms.

No. 4.—Sample from Walkerton, Ont., shows a water rich in lime and magnesia salts existing in solution in the water as bicarbonates and precipitating as their respective carbonates:

Total solid per imperial gallon	21	grains.
Insoluble suspended matter	.80	〃
Carbonate of lime	12.12	〃
〃 〃 magnesia	6.66	〃
Chloride of soda	1.20	〃
Also traces of alumina and peroxide of iron.		

Sample No. 5.—Sample of water from artesian well in eastern portion of the city of Montreal:

Total solids per imperial gallon	43.7	grains.
Insoluble suspended matter	2.04	〃
Carbonate of lime and magnesia	14.32	〃
Sulphate of lime	12.65	〃
Chloride of soda	9.38	〃
Alkaline carbonates and bicarbonates	5.31	〃

Sample No. 6.—Sample of water from factory at New Toronto, Ont:

Total solid grains per imperial gallon	141.6
Insoluble suspended matter	1.00
Alumina and peroxide of iron	.80
Carbonate of lime	27.48
〃 〃 magnesia	20.45
Sulphate of lime	37.36
Chloride of soda	54.60

A review of the impurities contained in these various samples shows very clearly how important this part of our subject becomes, and how widely different and varied in quantity are the impurities contained in the various feed waters throughout the country. I have said that when the nature of the impurities present is known that the effects resulting from the use of various waters for boiler feed purposes can be ascertained. This is well illustrated by the results obtained from the use of the various samples chosen for purpose of illustration from a large number of feed waters examined in my laboratory.

No. 1 and 2 I have already referred to at length. No. 3 is a class of water occasionally met with and predominating in some districts, and is a type of excellent water for the purpose indicated, and may be used without previous treatment with safety.

No. 4 is also a good boiler feed water, containing the whole of its impurities in such a condition that a physical change is all that is needed to render greatest portion of impurities insoluble, and consequently in such a condition that mechanical filtration will remove them from the water. As a matter of fact the users complain that while they had no scale in their boilers a very heavy scale formed in the heater, sample of which I received and analyzed with the following result:

Insoluble	.38%
Alumina and peroxide of iron	1.10%
Carbonate of lime	92.08%
〃 〃 magnesia	5.60%

Scale was light, very porous, and easily removed, and is a good example of the change taking place as set forth in last month's contribution on this subject when the water is sufficiently heated to drive off excess of carbonic acid and the insoluble carbonates of lime and magnesia are at once precipitated.

Sample 5 shows a type of water that has actually a double effect, a reaction setting up between the alkaline carbonates and the sulphates of lime and precipitating a sludge balance of sulphate of lime bonding with carbonates of lime and magnesia and forming heavy scale.

Sample 6 shows a sample of water that belongs to a class that should not be used for boiler feed purposes if any other water can be obtained, and requires both chemical and mechanical treatment, scale formed from this water, as is to be expected from composition of impurities, being exceedingly hard, tenacious and troublesome.

(To be Continued.)

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To Our Readers.

THE series of instructive articles on electricity and steam engineering by Mr. Wm. Thompson, which have appeared in our Educational Department each month during the last year, will shortly come to a close. We have received assurances from many quarters as to their practical value. The object in their preparation was to furnish, in a form to be easily understood by those who had not the advantage of a technical education, the underlying data and principles on which a thorough knowledge of these subjects must rest, and which of itself would prove extremely helpful to those desirous of fitting themselves to intelligently operate electrical and steam machinery. Our readers of this class will no doubt be pleased to learn that this series of articles will shortly be published in the form of a pocket hand-book, at a very moderate price. Further particulars will shortly be given in these columns.

Proposed Greater Britain Exhibition.

ARRANGEMENTS are well under way for the holding of what is termed a Greater Britain Exhibition at Earl's Court, London, next year, lasting from May until October. The undertaking, which is under the direct management of the London Exhibitions, Limited, a company formed in 1894, and having a paid-up capital of £145,000, is receiving the approval and support of the Marquis of Lorne, Sir Charles Tupper, and other distinguished British and Colonial statesmen. The object, which is to bring together the products of the various parts of the British Empire, should commend itself to all who wish for a closer commercial relationship between Great Britain and her colonies. The Canadian government will be asked to grant an appropriation to cover the cost of a Canadian exhibit. Attention is called to the fact that exhibits intended for the Paris Exhibition of 1900 might with advantage and little additional cost be first shown at the London Exhibition. In view of the prevailing sentiment on both sides of the water in favor of closer trade relations, Canada should take advantage of every opportunity to make known her resources.

Acetylene Gas.

APROPOS of the article published in a recent number of the ELECTRICAL NEWS anent the dangers attending the use of acetylene gas, we reprint from the daily papers the following despatch dated Guelph, March 23: "A show, the Erin & Brennan Co., appeared in the City Hall here last night. There was one real act in the show not on the programme. An acetylene gas generator exploded during the early part of the proceedings. One of the performers was passing the generator with a lighted candle, which ignited the escaping gas. Explosion after explosion followed, and some of the scenery took fire. Mr. Brennan, one of the company, and caretaker Ryde, managed to smother the flames. Ryde had his hands badly burned by carrying the tank down-stairs. The stage carpet, piano cover and a couple of sets of scenery are badly scorched." Apart from the dangerous character of acetylene, it is being found out now that it cannot compete with a fairly reasonable supply of electric light or gas from a central station. In everyday practical operation it costs more than either, with the trouble and stench extra, as witness the following extract from the Kincardine Reporter: "The Teeswater News has just had an interview with Mr. Brick regarding his experience in lighting the Vendome, one of the finest hotels in that section of country. Not being able to make good arrangements for lighting by electricity, Mr. Brick contracted for a 75 light acetylene gas plant, the fittings costing $175. The generator was outside in a separate frost-proof building, partly to meet insurance requirements and partly to obviate the objectionable stench in cleaning it out daily. After a trial of over three months Mr. Brick has discarded the acetylene gas plant, and has had the entire hotel fitted up with 66 incandescent electric lights from the town plant. He claims that electricity is not only cheaper than the gas, but that the objection to the acetylene is its offensive smell, its getting out of order, emitting a sooty discharge from the burners, and the amount of work necessary to keep the generator charged, all saved under the incandescent electric lighting system."

The Rights of Private Lighting and Water Companies.

In Pennsylvania the Courts have restrained municipalities from entering into competition with private water supply companies. In the New York Legislature a Bill has been introduced which seeks to add the following sub-division to the general corporation law: "Whenever any corporation shall be in the possession of or entitled to any rights, privileges or franchises within the limits of any municipal corporation, and shall be engaged in the exercise of the same or any part thereof, the municipal corporation within whose limits such rights, privileges or franchises are owned or exercised, shall not itself undertake to perform, within any land or territory, within which such corporate rights, privileges or franchises are or may be owned or exercised, the business or purposes to which said corporate rights, privileges or franchises relate, without first acquiring, in the manner prescribed by chapter 23 of the code of civil proceedure, the rights, privileges and franchises of said corporation, or to which said corporation is or may be entitled, and also the property of said corporation used in or necessary for the use or exercise of any of said rights, privileges and franchises." Legislation of similar character has already been enacted by the State of Massachusetts and by the British Parliament. With such a precedent before them, it is to be hoped the Ontario Legislature at its next session will accede to the request of the Canadian Electrical Association, representing the electric light and gas companies, for legislation which will render compulsory the purchase by municipalities at a valuation of the plant only of private companies whose business they may desire to assume. It will be observed that no effort is being made on behalf of these companies to prevent municipalities from engaging in the business of supplying electric light and gas. All that is asked is that in cases where a municipal corporation desires to usurp the functions of a private company, they shall be compelled to purchase only the plant of said company at a fair valuation to be fixed by arbitration. Legislation of this character is needed to prevent the wiping out of a large amount of private capital which was invested in electric light and gas plants at a time when such investments were attended by heavy risk and when no one supposed that money of the taxpayers, including, of course, those who had invested their means in the private company, would in some instances be employed to purchase and operate a competing municipal plant.

Steam vs. Heat Engines.

We often see in the various papers as read at some of the engineering societies statements regarding the great inefficiency of the steam engine, and that there is considerable room for improvement. No just comparison can be made between any machine and a heat engine, and to say that the steam engine is very inefficient is only partially correct. Some engines as mechanical devices give efficiencies as high as 90%, which certainly does not leave a very large margin for improvement. The amount of work got out of a heat engine depends entirely on the ABSOLUTE temperatures between which it is worked, and to obtain the whole work from a mass of heated air, it would be necessary to cool it down to absolute zero, which is utterly impossible in practice. The work done or given out by a heat engine in one revolution is expressed as follows:

$$W = J\,H\left(\frac{T_2 - T_1}{T_2}\right)$$

Where J = Joule's mechanical equivalent.
H = Heat units given up.
T_1 = Final absolute temperature.
T_2 = Initial absolute temperature.

From which we get the efficiency as being $\frac{W}{J\,H} = \frac{T^2 - T^1}{T_2}$ Suppose the initial pressure in a steam cylinder was 100 lbs., and the final pressure 5 lbs., and treating it as a heat engine we have an efficiency of $\frac{797 - 687}{797} = .14$, when 797 and 687 are the absolute temperatures of steam at 100 lbs. and 5 lbs. respectively. Now this same engine may have a mechanical efficiency of 85%. It is through no fault of the engine that its efficiency is low, when treated as a heat engine, but is the result of a law in thermodynamics, where only a fraction of the heat supplied is available for being transformed into another form of energy; this fraction is as shown above, viz., $\frac{T_2 - T_1}{T_2}$, Joule's mechanical equivalent being 772 foot lbs. One h. p. hour is equal to 2565 heat units. Taking a very economical plant, where 2 lbs. coal are required per indicated horse power, and that the calorific value of the fuel is 12,000 heat units, we therefore get for every 24,000 heat units in the furnace, 2565 heat units at the engine. But the boiler only utilizes .75 of the total heat units; we therefore have .75 of 24,000 = 18,000 heat units in the boiler, giving us an efficiency of $\frac{2565}{18000} = .15$ nearly Considering this in another way, we have steam pressure 120 lbs., engine compound condensing, vacuum 26 inches. The absolute temperatures corresponding to these pressures are 810 and 586 respectively, giving an efficiency of 27%. Twenty-seven per cent. of 18000 is equal to 4860 heat units, and of this amount 2565 are converted into mechanical energy, showing clearly that the correct efficiency of this engine, working under these conditions, is $\frac{2565}{4860} = 52\%$.

SOME EXPERIMENTS ON THE CONDENSATION OF STEAM.*

By H. L. Callendar, M.A., F.R.S., Professor of Physics, and J. T. Nicolson, B.Sc., Professor of Mechanical Engineering, McGill University, Montreal.

PART I.

As the result of some experiments by electrical methods on the measurement of the temperature changes of the walls and steam in the cylinder of a working steam engine, which were made at the McDonald Engineering Building of McGill University in the summer of 1895, the authors arrived at the conclusion that the well-known phenomena of cylinder condensation could be explained, and the amount of condensation in many cases predicted from a knowledge of the indicator card, on the hypothesis that the rate of condensation of steam, though very great, was not infinite but finite and measureable. An account of these experiments was communicated to the Institution of Civil Engineers in September, 1896, and will, it is hoped, be published in the course of the ensuing session. In the meantime, the authors have endeavored to measure the rate of condensation of steam under different conditions by a new and entirely different method, with a view of verifying the results of their previous work, and also to estimate the influence, if any, of the film of water adhering to the walls of the cylinder.

In considering the condensation of steam on a metal surface it is usually assumed that the surface exposed to the steam is raised up to the saturation temperature corresponding to the pressure of the steam, and that the amount of condensation is limited by the resistance of the water films to the passage of heat from the steam to the metal and from the metal to the water. If the steam contains air, there may also be a considerable resistance due to the accumulation of a film of air on the surface, but it is comparatively easy to exclude this possibility in experimental work.

In the steam engine experiments above referred to, it was practically certain that the water film due to the cyclical condensation never exceeded one-thousandth of an inch in thickness, and that the resistance offered by it was unimportant. At the same time, it appeared clear that the temperature of the surface of the metal at its highest was considerably below the saturation temperature of the steam, a condition which could only be explained by supposing the rate of condensation of steam on a surface to be limited by some physical property of steam itself, apart from the resistance of the condensed film of water. Interpreted in this manner, the experiments led at once to the conclusion that the rate of condensation at any moment was simply proportional to the difference of temperature between the saturated steam and the surface on which it was condensing.

The limit thus found was shown to be capable of explaining many of the phenomena of cylinder condensation in a rational manner, but the method by which it was established was of an indirect and somewhat intricate character, and appeared to require some simple and more direct confirmation.

If the rate of condensation of steam were really infinite, it should be possible by a suitable modification of the surface-condenser method (i.e., by getting rid of the water films on the outside of the tubes) to obtain values of the condensation considerably in excess of those given by the formula deduced from the temperature cycle observations.

To accomplish this it is necessary to eliminate as completely as possible the resistance to the passage of heat through the water films between the steam and the metal, and between the metal and the circulating water, and at the same time to measure as accurately as possible the temperature of the metal.

These conditions led to the form of apparatus which was employed. The resistance to the passage of heat from the metal to the condensing water in this apparatus is practically eliminated by employing a thick cylinder, 5 in. diameter and 2 ft. long, with a screw thread cut on its outer surface. Water from the high-pressure mains is forced to circulate round this surface with a very high velocity in the narrow space between the cylinder and the surrounding tube. In this manner it is possible to obtain a very uniform temperature for the external surface differing but little from that of the circulating water.

If the cylinder is made sufficiently thick, its temperature may be approximately determined at any depth by inserting mercury thermometers. It was intended at first to use thermocouples for this purpose, but the apparatus in this form would have been unsuitable for students' use in the ordinary course of laboratory work, which was one of the primary objects in view in the construction. It would also have been desirable to make the cylinder of nearly pure copper, which would have reduced the resistance of the metal to the lowest point. The authors were compelled, however, to content themselves for the time with cylinders of cast iron and mild steel.

The internal surface of the cylinder, upon which the steam was condensed, was a hole one inch in diameter, drilled in the solid metal. In order, as far as possible, to minimize the resistance of the surface film of condensed water, a revolving brush was constructed of very thin strips of steel to wipe the surface five or six times a second. This wiper was found to wear in a very short time to so perfect a fit, and the water film must have been so energetically stirred, that its resistance to the passage of heat must have been far less than that of the best conducting metal, when there was perhaps some small film present.

Under these conditions, if the rate of condensation of steam were infinite, it should have been possible to obtain a rate of condensation many times greater than the limit deduced from the cylinder condensation experiments above mentioned.

On making the experiment, however, it was found that the wiper made very little difference to the amount of condensation. With the wiper revolving at the rate of 160 per minute, the condensation was increased by about 5 per cent. on the average of several experiments. It may be concluded from this that the drops of condensed water with which the surface is partially covered are in such rapid motion that they do not appreciably obstruct the passage of heat from the steam to the metal. In fact, Prof. Callendar actually found that the drops increased the condensation. A film of the same average thickness, if it were absolutely quiescent, and if its conductivity, as generally estimated, were only one-hundredth of that of cast iron, would no doubt prove a serious obstacle; but, as a matter of fact, the viscosity of water at these temperatures is so small, and the motion so rapid, that the drops cannot be treated as a quiescent film.

The temperature at various distances from the inner surface of the cylinder was determined by means of mercury thermometers inserted to a depth of 8 in. or 9 in. in holes drilled parallel to the axis. From the temperatures so observed the conductivity of the metal and the temperatures of its inner and outer surfaces could be approximately inferred. It was found, however, that the presence of the holes interfered materially with the flow of heat through the metal, and that the readings of the thermometer under these conditions were not altogether trustworthy.

From a number of observations on the cast-iron cylinder a conductivity of 5.5 thermal units Fahr. per square ft. per minute per deg. Fahr. per inch was deduced, a result which agrees very closely with the authors' previous determination by a different method. For the steel cylinder a conductivity of 5.8 was similarly deduced. These results apply to a mean temperature of about 140 deg. Fahr., and are much lower than the values generally assumed for iron.

In order to verify the previous results as to the rate of condensation of steam derived from the steam engine experiments, the temperature of the inner surface of the metal was calculated on the assumption of a rate of condensation equivalent to 0.74 thermal unit Fahr. per second per square foot per deg. Fahr. difference of temperature. The values so found agreed with the observed temperatures within the limits of error of the observations. Owing to the inferior conductivity of the iron the test was not absolutely conclusive, as the difference of temperature between the steam and the surface rarely amounted to as much as 30 deg. With a cylinder of pure copper, and thermocouples for determining the temperature at a given depth, it should be possible to obtain a more certain confirmation by this method.

In performing the experiments a number of variations in points of detail were introduced from time to time. The flow of the circulating water was varied in velocity and directed in different ways. In order to secure uniformity in the distribution of temperature measured in different directions from the centre, the spiral circulation was found to be essential. In the second apparatus the screw thread was at first replaced by a baffle-plate, which was intended to direct the water into a spiral course, but the results found were unsatisfactory.

In some cases steam was admitted from the top of the apparatus and in other cases from the bottom. With the steam supply at the bottom, it was found that condensed water refused to drain down the vertical 1 in. tube in opposition to the current of steam, although the maximum velocity of the steam could not have exceeded 10 ft. per second.

The following set of observations, each of which represents the mean of several taken on similar conditions, will sufficiently indicate the general nature of the results:

The temperatures of the metal at distances of 1 in., 1.5 in. and

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* Paper read before the Institute of Civil Engineers, London, England.

2 in. from the axis of the bar were observed by means of mercury thermometers, which were very carefully centred by small iron washers in holes filled with mercury. The hole fitting the bulb of the thermometer was 3-16 in. in diameter. The other holes were 5-16 in.

It will be observed that in this particular set of experiments the temperatures at 1 in. in the metal, when calculated to agree with the assumed rate of condensation, are all too low as compared with those observed, whereas the temperatures similarly calculated at 1.5 in. are all too high. This might at first sight appear to indicate a very rapid diminution of the conductivity with rise of temperature; but after making various tests the effect was traced partly to the disturbance of the heat flow caused by the presence of the holes, and partly to differences of density of the bar in directions at right angles. The latter differences were not observable in the case of the cast iron.

The observations taken at different pressures do not indicate any marked difference in the rate of condensation per degree second. These results, so far as they go, are in agreement with the authors' previous work, but they hope to obtain more conclusive evidence.

AN ELECTRICAL METHOD OF MEASURING THE TEMPERATURE OF A METAL SURFACE ON WHICH STEAM IS CONDENSING.

By H. L. Callendar, M.A., F.R.S., Professor of Physics, McGill University, Montreal.

Part II.

The objects of the following experiments, which were made at the McDonald Physics Building with a different apparatus, was the measurement of the temperature of the metal surface itself by a more direct and accurate method. It was also desired to verify as exactly as possible whether the rate of condensation of steam at atmospheric pressure was the same as at the higher temperatures and pressures at which most of the preceding experiments were made.

The condenser used for these experiments was a very thin platinum tube, ¼ in. in diameter and 16 in. long. The thickness of the tube was only six-thousandths of an inch, and the greatest difference of temperature between its inner and outer surfaces at the maximum rate of condensation observed in the experiments could not have been greater than ¼ deg. cent.

The mean temperature of the metal itself was determined in each case by measuring the electrical resistance of that portion of the tube on which the steam was condensing. The author has had considerable experience in the employment of this method, which, moreover, is very easily applied if suitable apparatus is available.

The platinum tube was enclosed in an outer tube of brass or glass, and steam was admitted to the space between the two tubes. A steady current of condensing water was maintained through the platinum tube. The amount of condensation could be inferred by measuring the flow of water, and observing the difference of temperature between the inflow and outflow. In many cases the condensed water was also measured. Applying a small correction for radiation, the two methods always agreed with one-half of 1 per cent. The pressure of the steam in the outer tube, which was never far from the atmospheric, was observed by means of a mercury column.

The conditions of the experiment as to flow of water and steam, size and length of the external tube, etc., could be varied within certain limits. The following is a summary of the more interesting results obtained:

Condensation Results Summary. Mild Steel Bar. Wiper Removed.

Condensation. Thermal Units per Square Foot Second.	Steam Temperature Observations.	Surface Temperature Calculations.	Difference, Steam and Surface.	Temperature in Metal at Distances.					Conductivity, K.
				1 in.		1.5 in.		2 in.	
				Calculations.	Observations.	Calculations.	Observations.	Observations.	
	deg.	deg.	deg.	deg.	deg.	deg.	deg.	deg.	
20.0	330	303	27	208	214	154	152	113	5.84
17.8	300	277	23	193	198	143	142	100	5.66
15.78	274	253	21	179	184	136	134	103	5.81

1. With a short length of condenser and a very free escape of steam, the condensation observed was equivalent to 22.2 thermal units Fahr. per square foot per second, for a difference of temperature of 28.5 deg. Fahr. between the steam and the metal surface. This is equivalent to a rate of condensation of 0.78 thermal unit Fahr. per degree second, reckoned per square foot of the surface of the metal. This was the smallest value of the rate observed. The platinum tube was vertical, and the current of steam downwards, conditions which tented to keep the surface of the metal comparatively clear of condensed water.

2. With the same conditions, but with a length of tube nearly twice as great exposed to the steam, the condensation observed was 22.3 thermal units Fahr. per square foot per second, for a difference of temperature of 25.3 deg. Fahr. This gives a rate of 0.88 per degree second. The lower half of the tube was more thickly covered with water than the upper half, the steam also was full of flying spray, which may have assisted in conveying heat to the metal, and in maintaining the same rate of condensation on the lower half of the tube as on the upper half, in spite of the somewhat higher temperature of the circulating water in the lower half.

3. With the same arrangement, but with the steam current reversed and reduced until the escape was as gentle as possible consistently with keeping the tube full of steam and entirely excluding air, a somewhat larger rate of condensation was observed, namely, 23.6 thermal units Fahr. per square foot per second. The pressure throughout the tube was very nearly atmospheric, and the gentle upward current of steam tended to keep the tube very thickly covered with drops and rivulets of water. The difference of temperature was only 22.0 deg. Fahr., giving a rate of condensation of 1.07 thermal units Fahr. per degree second. This is equivalent to 2.25 watts (joules per second) per square centimeter per 1 degree cent., and was the largest value observed throughout the work. It would appear probable that the surface exposed by the drops is so much greater (in the present instance about twice as great) than the surface of metal, and the drops themselves are in such rapid motion, that the increase of surface, by facilitating condensation, more than compensate for any resistance which the water film may offer to the passage of heat to the metal.

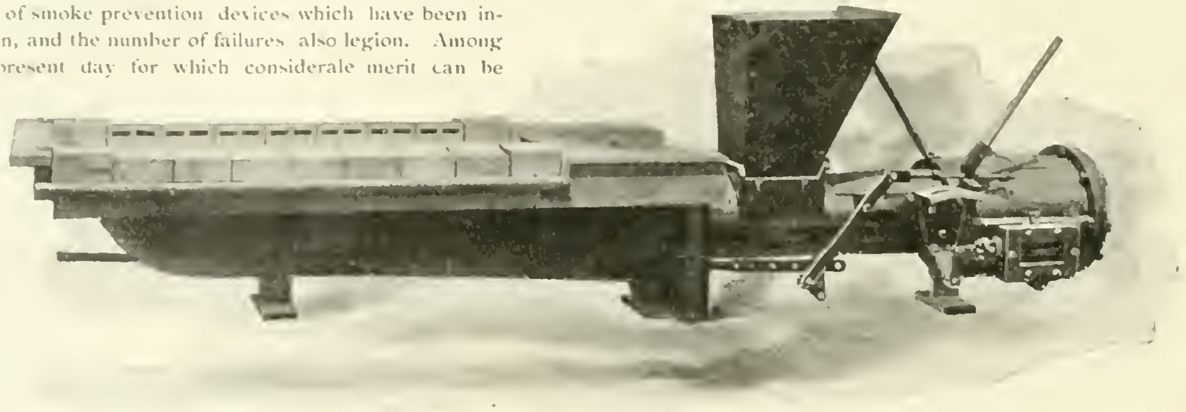
4. To verify this view the outer glass tube was replaced by a much smaller tube, so as to leave very little space for the steam current. The pressure of the steam was thus raised to nearly 4 in. of mercury above the atmospheric at the entrance of the tube, and the surface of the platinum was violently scoured by a spiral rush of steam and spray. Under these conditions the condensation observed was reduced to 19.2 thermal units Fahr. per square foot per second, instead of being increased as might naturally have been expected with so strong a current of steam. The effect of the energetic scouring of the metal surface was shown by a slight rise of temperature of the metal as compared with previous experiments. The observed difference of temperature between the metal and the steam in this case was 19.8 degrees Fahr., giving a rate of condensation of 0.97 thermal unit Fahr. per degree per second.

From these and similar observations in which the conditions of the experiments were varied to a certain extent in points of detail, it may be concluded that the presence of water on a metal surface may tend to increase rather than diminish the amount of condensation. The rate of condensation of steam at 212 deg. Fahr., allowing for the fact that in these experiments the surface was unduly increased by the presence and the motion of the water drops, would appear to be at least of the same order of magnitude as the value deduced from experiments on the cyclical condensation in the cylinder of a working steam-engine, in which the temperature of condensation varied from 290 degrees to 330 degrees Fahr., and the rate deduced was 0.74 thermal unit Fahr. per square foot per degree per second. Since, however, it is impossible that the latter value was diminished to an uncertain extent by a slight film of grease on the hot and dry surface, and since the value deduced from the suface condenser method is, perhaps, a little too large, owing to the presence of the water film, it would be unsafe to conclude that the rate of condensation is the same at different temperatures, although the evidence, so far as it goes, appears at present to point in that direction. Comparing the three different methods of experiment, which all lead to a similar result, it may be regarded as highly probable that the old view of an infinite rate of condensation requires revision, and that the value of the rate of condensation of steam on a metal surface, as determined by the author's previous experiments, is at least a first approximation to the truth. The question at issue is one of fundamental importance in the theory of the steam engine, and the authors have shown in the paper already quoted that, if the law of condensation there proposed be admitted, a number of interesting practical deductions can be made, and problems may be solved which have not hitherto been regarded as amenable to other than empirical treatment.

THE JONES' UNDERFEED MECHANICAL STOKER.

It is over 100 years ago since the first mechanical stoker was made. In 1785 James Watt patented a device for pushing the coal from the front end of the grate, after it was coked towards the bridge wall. It was worked by levers and the prime object was to prevent smoke when using bituminous screenings. Since then the best inventive genius in the world has been striving to perfect a smokeless furnace.

The number of smoke prevention devices which have been invented is legion, and the number of failures also legion. Among those of the present day for which considerale merit can be claimed is the Jones' Underfeed Mechanical Stoker, which is said to be a truly smokeless and economical device, and one which meets the demand for economy which is now so essential in all power plants where steam is used. To give our readers a better understanding of this invention we give some illustrations herewith, as well as some particulars of its construction, operation and application.


Improved Jones' Underfeed Mechanical Stoker.

The stoker consists of a steam cylinder or ram, with hopper for holding the coal, outside the furnace proper, and a retort or fuel magazine, inside the furnace, into which the green fuel is forced by means of the ram; Tuyere blocks, for the admission of air, being placed on either side thereof; the retort containing at its lowest point, and at a point where the fire never reaches, an auxiliary ram or pusher by means of which an even distribution of the coal is obtained.

By means of the rams coal is forced underneath the fire, each charge of fuel raising the preceding charge upward, until it reaches the fire, which point it does not reach until it has been coked, when in its coked state it is forced upward into the fire. The gases being liberated under the fire, and at that point mixed with air, must necessarily pass through the fire and be consumed, thus giving the benefit of all combustible matter in the fuel.

Terauley Street Station, Toronto Electric Light Co.

Air is forced, at a low pressure, through the Tuyere blocks, under the burning fuel, by means of a blower, operated by an independent engine, or from a line shaft, if such arrangement can be made.

As to the operation of the stoker: We will suppose that the furnace is being fired without steam in the boiler. The retort is first filled with coal, level, or a little above the tuyere blocks. Fire is then started by placing kindling or greasy waste, lighted, along each side of the retort and opening wide the air chamber reaching to the tuyere blocks. As soon as sufficient steam is raised to run the blower, air chamber opening is closed, blower is used for furnishing air, and fire will be built up very rapidly.

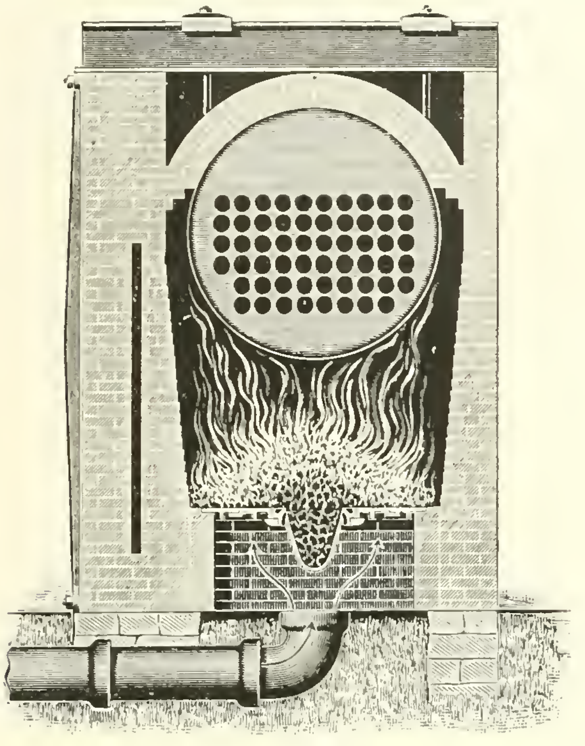
Coal being in the hopper, and the ram plunger at its forward stroke, when more coal is needed the ram plunger is shifted by moving the lever; coal then falls in front of plunger and upon return movement is forced into the retort, this movement being repeated until sufficient fuel is in the retort. After fire is properly started, never make more than two charges of the ram at a time, as by so doing green coal is forced into the fire, which will produce imperfect combustion and consequently smoke.

Air, at low pressure, being admitted into the air chamber and through the tuyere blocks, over the top of the green fuel in the retort, but under and through the burning fuel, the result is that the heat from the burning fuel over the retort slowly liberates the gas from the green fuel in the retort. This gas being thoroughly mixed with the incoming air before it passes through the burning fuel above, results in a bright clear fire, free from smoke, and the complete consumption of all the heat producing elements in the fuel. The retort being air tight from below, and the fuel being in a compact mass in the retort, the air will find its way in the direction of the least resistance, which is upward, consequently combustion takes place only above the air slots, hence the castings of the retort are always cool and not subject to the action of the fire. The incoming fresh fuel from the retort forces the resulting ash and clinker over the top of the tuyere blocks on to the side plates, from whence they may be removed at any time without in the least interfering with the fire in the centre of the furnace, resulting in a high, even temperature at all times.

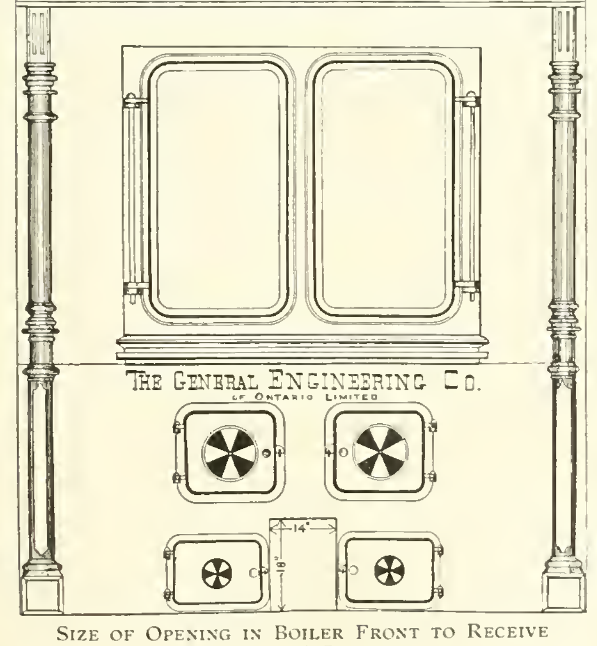
To secure the best results a heavy body of coke should at all times be carried in the furnace, as nearly like the illustration as possible. The amount of coal consumed is regulated entirely by the quantity of air forced in the furnace, so that when little steam is needed the quantity should be reduced.

The Jones' stoker may be applied to practically all types of boilers. It will also burn any kind of bituminous or lignite, slack or screenings, with a substantially smokeless stack. The manufacturers claim that competitive tests have shown a difference between the stoker and ordinary hand firing of from 20 to 35 per cent. in favor of the stoker.

Another advantage claimed for the device is that it removes the necessity of high chimneys, and is therefore economical. To illustrate, let us consider the difference in cost between two power plants, say of 2,000 h. p., one with high chimney, natural draft, and plain furnaces, and the other fitted with the Jones' Underfeed Mechanical Stokers. The cost of the first plant, exclusive of the building, would be approximately (ten boilers, including setting, $36,000, and the chimney, say 100 feet high by 7 in diameter) $40,500. In the second plant it is necessary to put in only eight boilers to get the same results as far as power is concerned, leaving out of the question for the present the increased efficiency, and a short stack of from twenty to thirty feet high being sufficient The cost of the eight boilers, including the setting, would be $28,800, and this, together with the stokers and the chimney, makes a total of $35,800, or a saving in the first cost of $4,700, which is more than the cost of the chimney. There is also a reduction in boiler repairs, interest, taxes, etc. We come next to the saving of coal. Taking the plant as above specified, ten boilers burning say 400 pounds per hour each, amounting to twenty tons per day of ten hours, with hand firing, against eight boilers burning the same quantity per boiler per hour for the same results = sixteen tons daily, or a daily saving of four tons, equal to over $3,000 yearly. We have, therefore, a saving in first cost of $4,700, and a yearly saving of over $3,000.



Cross Section Showing Furnace in Operation.



Size of Opening in Boiler Front to Receive the Jones' Stoker.

Engineers and others who wish to learn more of this invention should address the manufacturers, the General Engineering Company of Ontario, Limited, 80 Canada Life Building, Toronto They have recently issued a hand-book descriptive of the stoker, in which are also found many valuable tables and other useful data.

SPARKS.

A. McDonald, electrician, New Denver, B. C., is reported to have gone out of business.

The incorporation is announced of the Rotary Engine Company, of Woodstock, Ont., with a capital of $24,000.

The Hull Electric Co. are building a 400 foot water chute at Aylmer Park, which it is expected will prove a great attraction during the summer months.

The Chateau Frontenac Hotel in Quebec is now heated by four Babcock and Wilcox boilers, which have been installed in the new wing recently completed.

The city council of Halifax, N. S., is now discussing the question of installing a municipal electric light plant. The matter has been referred to the electrician for a report.

The Dawson City Electric Co. is applying for incorporation to supply electric light, heat and power throughout the city and within a radius of 200 miles, as well as to operate an electric tramway.

The Canadian General Electric Company have closed the contract with the Laurentide Pulp Company, at Grand Mere, Que., for two 55 kilowatt moderate speed current dynamos, with marble panels and instruments complete.

A special meeting of the Merchant's Telephone Company was held in Montreal last month, at which it was announced that the company had obtained authority to increase its capital to $1.000,000. The annual meeting will be held on the second Thursday in April.

The London Electric Company are increasing the generating capacity of their station to meet the large demands for light and power, and have placed an order with the Canadian General Electric Company for one of their standard 300 kilowatt single phase alternators and two 160 K. W. direct-connected power generators of their latest type.

The Montreal Cotton Company, of Valleyfield, Que., have just placed an order with the Canadian General Electric Company for two 600 H P. three phase generators, to be direct-connected to turbines. This installation is a duplicate of the generators installed by the Canadian General Electric Company over a year ago. With these four generators and station apparatus the company will have one of the most modern power stations on this continent.

The Hull Electric Company is suing the Ottawa Electric Co. for damages and infringements of the charter granted by the city council of Hull in 1894, by which the Hull company were granted the exclusive privilege for electric lighting. The Ottawa company contend that their right to erect poles within the city of Hull, for lighting purposes, was expressly guaranteed to them by a by-law passed by the city council six years previous to the Hull company's charter. The case is being bitterly fought.

At the annual meeting of the Lachine Rapids Hydraulic & Land Co., held in Montreal recently, the financial statement for the year ending December 31, 1897, showed that in the last two months sufficient revenue had been earned to pay the interest of 6% on the six months bonds. Over 1,000 customers were on the line, and in the neighborhood of 25,000 lights had been installed. It was announced that a five years' contract had been signed with the Imperial Light & Power Company, by which power for lighting, etc., would be supplied by the Lachine Company, and used for lighting the east end. A contract had also been signed with the Standard Light & Power Co., to supply them with power for straight current purposes, and, in turn, the Standard Company had acquired the entire plant, franchise and business of the Temple Electric Co., and would take possession on May 1st

The telegraph line to be built by the C. P. R. between Montreal and Vancouver, referred to in a recent issue, will cost $250,000. The wire to be used will be of copper, 300 lbs. to the mile, and will weigh about 450 tons. It is being manufactured by the Dominion Wire Manufacturing Co., of Lachine, Que., and will be tested at McGill University under the direction of the officers of the company. Mr. Jas. Kent, the Montreal superintendent of the company, gives some interesting details regarding the construction of the line. The short pieces of wire which will be used to tie the telegraph wires to the insulators will have a total weight of 6½ tons. Allowing two inches slack between each pole, owing to it being impossible to draw a line perfectly straight, will add four miles of wire to the line between Montreal and Vancouver. Leaving a small bundle of wire with each lineman for repairs will use up 20 miles of wire. The joints, which it is necessary to make at the end of each bundle, will require one mile of wire.

Mr. H. R. Leyden, manager of the Cataract Power Co., has made a proposition to pump the water supply of the city of Hamilton, Ont., by electric power. He agrees to erect at the beach pumping house electric motors and revolving screw pumps of sufficient capacity to pump 10,000,000 gallons per day, and to erect at the high level pumping house motors and pumps and supply sufficient power to pump from the mains to the high level reservoir 2500 gallons per day. The company will keep the pumps in operation for one month, when the city will be expected, if satisfactory, to pay for them at the ascertained cost, not to exceed $25,000. The price to be paid by the city for electric current necessary for pumping the water required is placed at $13,000 per year for the first 1,600,000,000 gallons pumped in both reservoirs, and 6c cents for each additional 100,000 gallons. The company claims that its offer will meet the requirements of the fire underwriters and save the city more than $20,000 per year.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein all the mechanical and electrical formulæ and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering all the wisdom of the work practically valueless to the reader.

Just at what particular point our educational articles should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS (Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

[ARTICLE XII.]

REQUIRED SIZE OF LEADS IN CIRCULAR MILS.

A MIL is $\frac{1}{1000}$ of an inch, and written decimally .001. The area of a circle $\frac{1}{1000}$ of an inch in diameter is termed a circular mil, and a great many wire tables express the area of the cross section of a wire in circular mils written symbolically C. M. Rules for the sizes of wires as met with in engineering practice for given resistances are often based on circular mils, and include a constant for the conductivity of material of which wire is composed. From this, then, we can construct a formula for the calculation of the resistance of wire of whatever material composed, so long as we know the specific resistance of the material.

Commercial copper wire of 90% purity, one foot long and one C. M. in cross section, is said to have a resistance of 10.79 ohms at 75° F. (approximate). In accordance with the rule that the resistance of a circular conductor varies inversely with the square of its diameter and directly with its length, we can construct the following well-known formula for the determination of resistance of copper wire:

$$R = \frac{10.79 \times L}{d^2}$$

Example (10): A commercial copper wire one-half an inch in diameter has a specific resistance of 10.79, what is the resistance per foot?

$\frac{1}{2}$ inch = .500 mils.
$.500^2 = .250,000.$
$10.79 \div .250,000 = .000043$ ohms per foot.

Example (11): A copper wire 5,000 feet long, with a cross section of 8,000 C.M., what is its resistance?

$$\frac{10.79 \times 5,000}{8,000} = 6.743 \text{ ohms.}$$

The required cross section of a wire in C. M. is equal to its length divided by its resistance and multiplied by 10.79, or

$$\text{C.M.} = \frac{L}{R} \times 10.79$$

The required cross section of a pair of leads in C.M. for a given drop is found to be equal to the product of the length of leads multiplied by number of lamps (in parallel) by 21.58 by 100, minus the percentage of drop, and the whole divided by the resistance of one lamp hot multiplied by the percentage of drop allowed.

$$\text{C.M. or } d^2 = \frac{L \times 21.58 \times N \times 100 - \%}{R \times \%}$$

or what is the same thing,

$$\text{C.M.} = \frac{10.79 \times 2 \times L \times N}{R} \times \frac{100 - \%}{\%}$$

Example (12): Ten lamps are to be placed in multiple at the end of a double lead 100 feet long. The resistance of each lamp when hot being 220 ohms, what must be the sectional area of the wire if a drop of 5% is allowed on E.M.F.?

$$\frac{21.58 \times 100 \times 10}{220} = 98 \times \frac{100 - 5}{5} = 1872 \text{ C.M.}$$

Based on this and following out the principles laid down in Ohm's Law, the following formula is often given as a ready means of determining the required size of wire for house or secondary incandescent circuits:

$$\text{C.M.} = \frac{21.58 \times L \times N \times C}{L\,v}$$

Where C.M. = Area in circular mils.
" L. = Length of one side of lead.
" N. = Number of lamps.
" C. = Current required by each lamp.
" L v = Number of volts per lamp loss in line.

When lamps or groups of lamps or other appliances are placed at different distances from the generator, apply principles laid down in example; or, roughly stated, determine first the size of wire required for each lamp or group, as if on independent circuits, starting from the dynamo, then combine all wires running in same direction.

DETERMINATION OF THE MEAN PRESSURE THROUGHOUT THE STROKE WHEN USING STEAM EXPANSIVELY.

Considering recent advances in modern engineering and improved appliances at hand, an article on this subject is perhaps superfluous. There are, however, such important principles involved and such useful information obtainable, that the author feels justified in referring to the subject at short length. Since a large proportion of my readers are operating simple non-condensing engines, the author will deal particularly with this class, and the principles involved can then be readily applied to compound engines of any type.

The engines to which many of us were first introduced had what is styled a fixed "cut-off," which took effect at almost any point between start and finish of piston travel, according to the views the engineer held on the question of working steam expansively. And speed was controlled by means of a throttling device, arranged to reduce or raise the pressure against the piston as occasion required. This type in modern practice is nearly obsolete, and we have in its stead what is termed an automatic "cut-off" engine, arranged to take steam at beginning of stroke at full boiler pressure, and regulating its speed by means of a variable "cut-off"—that is, initial pressure against piston on admission remains constant and varies only as pressure on boiler varies;—and this pressure is maintained against the piston as it travels within the cylinder to a point of the stroke varying in direct proportion as the load on the engine varies.

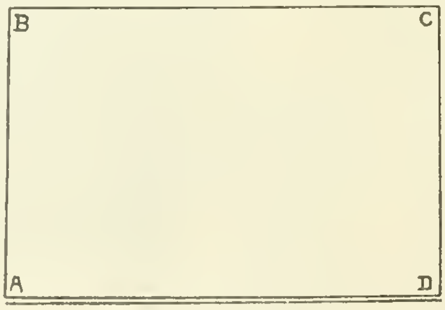


FIG. 5.

Theoretically, then, if we had no cut-off until admission valve closed at the end of the stroke, the pressure of the steam against the piston would remain the same, and a diagram representing the operation could be drawn as represented in Fig. 5, within the letters, A, B, C, D, and the pressure against the piston can be readily ascertained by a simple process at any point of the stroke, and the mean, initial and terminal pressures would at all times be equal, and the mean effective pressure would be initial pressure minus back pressure, and could be equally as readily determined.

Let us now suppose that when the piston has reached a point equal in distance to one-third of its travel, the admission valve closes and cut-off takes place; the piston then travels the remaining two-thirds of the distance by the expansive force of the steam already admitted, and supposing that expansion would take place under isothermal conditions, that is, that the temperature of steam remained constant, it is clear that as expansion increases pressure decreases, consequently the terminal pressure of the steam will be very much less than the initial pressure, and that at any point in the stroke between one-third and the end, the pressure will be less than the point immediately before and higher than the next succeeding point. If, then, we know the initial pressure of our steam and the point of cut-off, and can by any means determine the pressure at the respective points of the stroke, we can by finding the mean of these pressures thus determine the mean pressure on the piston. For this purpose, then, we re-arrange Fig. 5 as illustrated in Fig. 6, and divide this into any even number of points, taking care that one of these points shall coincide exactly with and intersect point of cut-off.

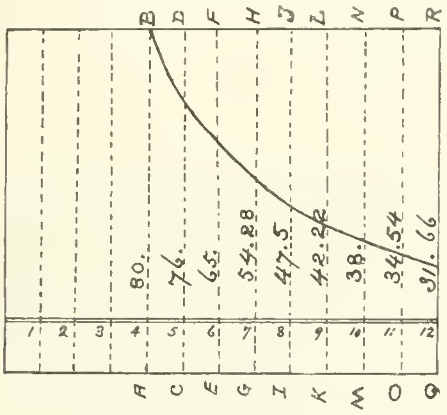


Fig. 6.

To do this we first divide the cylinder into an equal number of parts by subtracting the numerator from the denominator of the point of cut-off expressed as a fraction, and if the result is an even number above six, the denominator of the fraction is the number of equal parts into which the cylinder can be divided so that one of the ordinates will exactly intersect the point of cut-off.

Example: With steam cut off at $\frac{3}{15}$ of the stroke, what number of parts must the cylinder be divided into?

As per rule, 15 − 3 = 12—an even number above six—therefore cylinder must be divided into 12 equal parts. It will, however, very frequently be found that when the numerator is subtracted from the denominator that either an odd number or an even number less than six is the result. In either case, double, treble or quadruple both the numerator and the denominator, and if this does not answer, increase fraction until you get a fraction giving the desired result.

Example: Suppose steam is cut off at $\frac{1}{3}$ stroke, into how many equal parts must cylinder be divided?

Proceeding as per rule, 3 − 1 = 2, an even number less than six, which will not answer.

$\frac{1}{3} \times \frac{2}{2} = \frac{2}{6}$, which is still too low; we continue the process until we reach

$\frac{1}{3} \times \frac{4}{4} = \frac{4}{12} = 12 - 4 = 8$, an even number higher than 6, and cylinder can then be divided into 12 equal parts.

Fig. 6 then represents a cylinder, and we proceed to divide into 12 equal parts, with cut-off taking place at $\frac{1}{3}$ of the stroke. Each of the dotted ordinates in this diagram then represents the position of the piston expressed in $\frac{1}{12}$ths of piston travel. Point of cut-off, or $\frac{1}{3}$ of stroke, will equal 4 of these parts, and the pressure of steam at 1st, 2nd, 3rd and 4th positions of piston remains constant.

When piston is in position, A, B, at 4, cut-off takes place, and at Q, R, exhaust valve opens. If steam then was expanding under true isothermal conditions, the lines, c, d, e, f, g, h, etc., show the gradual decreasing pressures of the steam due to expansion and pressures represented by letters, A, B, Q and R, show the total value of the steam during expansion.

To find the pressure of the steam at any one of the positions of of the piston during expansion, multiply absolute initial pressure of steam by number of ordinate at point of cut-off, and divide this result by the number of ordinate at which pressure is desired.

Example: With steam admitted at 80 lbs. gauge pressure, find the pressure at each of the ordinates in diagram.

80 + 15 = 95, absolute pressure.

95 × 4 = 380, value of steam previous to cut-off.

Then pressure at C D = $\frac{380}{5}$ = 76. pounds.
" " " E F = $\frac{380}{6}$ = 65. "
" " " G H = $\frac{380}{7}$ = 54.28 "
" " " I J = $\frac{380}{8}$ = 47.5 "
" " " K L = $\frac{380}{9}$ = 42.22 "
" " " M N = $\frac{380}{10}$ = 38. "
" " " O P = $\frac{380}{11}$ = 34.54 "
" " " Q R = $\frac{380}{12}$ = 31.66 "

To find total value of steam during expansion we require to find area of space enclosed by A, B, Q and R.

For this purpose we adopt the Simpson rule, which is: To the first and last ordinates add four times the sum of the even ordinates and twice the sum of the odd ordinates; one-third of this sum equals the area.

Then 4 or A B = 95 pounds.
5 or C D = 76 x 4 = 304 "
6 or E F = 65 x 2 = 130 "
7 or G H = 54.28 x 4 = 217.12 "
8 or I J = 47.5 x 2 = 95 "
9 or K L = 42.22 x 4 = 168.88 "
10 or M N = 38 x 2 = 76 "
11 or O P = 34.54 x 4 = 138.16 "
12 or Q R = 31.66 "

3) 1255.82
Value during expansion, 418.60 "

Before expansion, 380 pounds.
During " 418.60 "
Value during whole stroke, 798.60 "

If, now, we divide by number of ordinates used, we get mean pressure against the piston throughout the stroke.

798.60 ÷ 12 = 66.55 pounds.

If the engine piston was running against a perfect vacuum, then mean pressure throughout the stroke would be the mean effective pressure on which to calculate power developed by any engine in doing work, but this rarely, if ever, happens; therefore the absolute back pressure against the piston must be deducted, and we get

Mean pressure − back pressure = mean effective pressure.

Example: Find mean effective pressure on the piston of a non-condensing engine when mean pressure is 66 pounds per square inch and back pressure two pounds above the atmosphere.

2 + 15 = 17 pounds absolute back pressure, and 66 − 17 = 49 pounds mean effective pressure of steam on piston.

When principles of calculation are understood, formula for calculation can be considerably shortened by use of logarithms.

1st. The hyperbolic logarithm of the ratio of cut-off increased by 1 and multiplied by terminal pressure equals mean pressure.

2nd. The hyperbolic logarithm of the ratio of cut-off increased by one and multiplied by initial pressure, and result divided by ratio of cut-off, equals mean pressure.

3rd. Second rule minus absolute back pressure equals mean effective pressure throughout the stroke.

Example of Rule 1: Cut-off takes place at $\frac{1}{3}$ of stroke; the ratio of cut-off therefore is 3 ÷ 1 = 3, and the hyperbolic logarithm of 3 is 1.09861,

∴ 1.098 + 1 × 31.6 = 66.39 pounds, mean pressure.

Example of Rules 2 and 3:

$$95 \times \frac{1.098 + 1}{3} = 66.4 \text{ pounds, mean pressure.}$$

$$95 \times \frac{1.098 + 1}{3} - 17 = 49.4 \text{ pounds, mean effective pressure (M.E.P.)}$$

In addition to finding the mean pressure by process of calculation, we require also to find the mechanical efficiency gained by cutting off steam in comparison to steam being admitted during the whole of the stroke. This can be found by dividing the mean pressure by the terminal pressure absolute. Then 66.4 ÷ 31.6 = 2.098; or expressed briefly, the mechanical efficiency is the hyperbolic logarithm of the ratio of cut-off plus 1.

Finally, on this subject, we want to find the co-efficient of efficiency or a number expressing the practical efficiency of the steam, including the effect of expansion as compared with the duty of the same steam without cut-off or expansion and loss by back pressure.

Rule:

$$\frac{\text{Mean effective pressure} \times \text{Length of stroke}}{\text{Absolute pressure} \times (\text{Length of admission} + \text{Clearance})} = \text{The co-efficient of efficiency.}$$

Example: Find the co-efficient: Gauge shows 80 pounds; stroke 12 inches, cut-off taking place at $\frac{1}{3}$ of stroke, and mean effective pressure is shown to be 49 pounds, piston having $\frac{1}{4}$ inch clearance.

80 + 15 = 95, absolute pressure.

$$\therefore \frac{49 \times 12}{95 \times (4 + .25)} = \frac{588}{403.75} = 588 \div 403.75 = 1.45 \text{ co-efficient.}$$

ELECTRIC RAILWAY DEPARTMENT.

DOVER MUNICIPAL ELECTRIC TRAMWAYS.

We have been favored with a copy of a pamphlet containing an illustrated description of the Dover Municipal Electric Tramways, constructed by Messrs. Dick, Kerr & Company. It will be remembered that about one year ago Mr. J. A. Rutherford resigned his position as chief engineer of the Canadian General Electric Company to accept the management of the electric traction department of this well-known engineering firm.

The city of Dover was one of the first in England to adopt electric tramways on the overhead wire system. The pamphlet states that when, early in 1896, the Council was considering the question of railway construction, a comparison of the capital cost of building tramways for gas and electric traction was given as follows :

	Gas.	Electricity.
Cars (capacity 40 passengers)......	£5,600	£ 4,620
Trailers....	660	660
Machinery........	1,750	.....
Line equipment........	....	7,500
	£8,010	£12,780

For working the respective systems offers were made of 6½d. per car mile for gas, and 6d. for electricity, the latter to be reduced to 4½d. if the mileage exceeded 240,000 car miles per annum. The saving of a half penny per car mile, it was considered, would much more than pay the interest on the larger capital required for construction.

The road was constructed during the fall of 1896 and following spring and summer. The rails used are of the girder type, weighing 87 lbs. per yard, and are 30 ft. long and 6 in. deep. The gauge of the tramway is 3 ft. 6 in., which was determined by the extraordinary deference of the framers of the Tramways Act of 1890. With the exception of a short distance the tramway is single track. The conducting system is of the usual character.

Owing to the shortness of the line, it being only about 3½ miles, no feeders were provided. The current is distributed from a central switch pillar, about 4 feet high, of cast iron, and divided internally into two chambers. The rolling stock consists of eight motor cars and two trail cars. Power is obtained from the Dover Electric Supply Company. The fare charged is only one penny.

ELECTRIC RAILWAYS AND BICYCLES.

Major I. B. Brown, in making his annual report on the street railways of Pennsylvania, states that the receipts of the state street railways have considerably fallen off within the past twelve months. He regards the use of the bicycle by both business people and pleasure seekers as the main source of the reduction in the traffic of many street railway companies. He finds that in cities where the hills are steep and less favorable conditions for bicycle riding exist, the railway companies have not been affected by it to the same extent, but in many places it cannot be gainsaid that the bicycle has become a most formidable competitor of the street railway. In order to secure substantial confirmation of this view an observation was made in a leading street of Harrisburg about two months ago. The observation covered two days, from 7 o'clock in the morning to 6 in the evening. During that time 6,078 persons passed a given point, 1,962 in the cars and 4,116 on bicycles, i.e., 67.7 per cent. on bicyles and 32.3 per cent. on the cars, or more than two to one in favor of the wheel. The figures secured at Harrisburg are by no means exceptional.

The Toronto Street Railway Co. purposes carrying out a number of extensions this season. It is probable that the line will be extended to Oakville, and also that the City and Suburban Electric Railway will be purchased and operated as a separate road, as is now done in the case of the Mimico branch. The City and Suburban Company have 12 miles of rail laid between Toronto Junction, Weston and Lambton.

TORONTO RAILWAY COMPANY'S ASSESSMENT CASE.

The long standing litigation over the assessment of the poles, wires and tracks of the Toronto Railway Company was settled last month by the Court of Appeal, judgment being given in favor of the city.

When the city made the assessment on Ward 1 last year, the company appealed to the Court of Revision, which sustained the assessment. Then the company appealed and brought the matter before a bench of three judges, composed of Judge McDougall, County Judge of York, and the senior judges of the adjoining counties, Dartnell, of Ontario, and McGibbon, of Peel, who decided in favor of the company, Judge McDougall dissenting. In the meantime the Assessment Department went on and assessed the poles, wires, etc., of the company in the other wards of the city, and in each case the company appealed to the Court of Revision against the assessment, the Court of Revision, in view of the judgment of the three judges in the case of Ward 1, sustaining the appeal of the company. This placed the city in the position of being the appellant against the decision of the Court of Revision, and an appeal was taken to Judge McDougall, it being deemed unnecessary to call in the other two judges in this instance. Judge McDoagall, after hearing argument, reversed the decision of the Court of Revision and held that the company was liable for assessment. Then the company appealed from this decision to the Court of Appeal, with the above result.

By the decision the assessment of $452,277 against the company in Wards 2 to 6 is confirmed for 1898, which will probably yield between $7,000 and $8,000 in taxes. Next year a further addition to this assessment of about $85,000 for the First Ward will be made, making a total assessment of about $540,000.

SPARKS.

The International Radial Railway Co. will apply to parliament for an extension of time for the completion of its line to Guelph.

The Halifax Electric Tramway Company will spend about $50,000 in improving their plant. They have just installed two large generators.

Lowe & Farrell, of Hamilton, have been given the contract for stringing the power wire from Decew Falls to Hamilton, for the Cataract Power Company.

Messrs. Peters, Peters & Ings, on behalf of the local gas company, have made a proposition to the city to build a street car system in Charlottetown, P.E.I.

It is reported that Messrs. A. Tremblay & Frere, of Herbertville, Que., have purchased property at St. Alphonse with a view of constructing an electric railway there.

The Smith's Falls, Rideau and Southern Electric Railway Company applied at a recent meeting of the Smith's Falls council for permission to lay rails and erect poles in that town.

E. F. Hutchings, of Winnipeg, and others, ask power from the legislature to construct an electric or steam railway from Winnipeg along the east side of Red river to St. Andrew's rapids.

At the annual meeting of the Sandwich, Windsor and Amherstburg Electric Railway Company, the statement of receipts presented showed a marked increase over those of the previous year.

A by-law has been given its first reading in the St. Catharines city council authorizing the construction of an electric railway between that city and Port Dalhousie. Mr. H. C. Symmes is interested.

The projectors of the Hamilton, Chedoke and Ancaster Electric Railway Company state that the line will be built from Hamilton to Brantford, providing the city council buys the Mountain Drive for $12,000.

H. Abbott, of Vancouver, William Whyte, of Winnipeg, and others, have petitioned the provincial legislature for the incorporation of the Mountain Tramway and Electric Company, to construct an electric railway.

The Halifax Chronicle says that the electric tramway scheme from Halifax to Bedford, N.S., has been killed, so far as the Halifax and Bedford company is concerned. Their charter has been amended so as to enable them to build a tramway only from Three Mile House to Bedford, and to supply electric lighting between the same two points.

The Council of Peterboro', Ont., again discussed at a recent meeting the proposed extension of the electric railway to Chemong and Lakefield. The promoter of this road is Mr. D. A. Starr, of Cornwall, who estimates the cost at $350,000. The council resolved to submit a by-law to the ratepayers to guarantee interest on one-third of the company's expenditure for 10 years at 5 per cent., the sum guaranteed not to exceed $100,000.

By an agreement entered into upon the commencement of the road, Mr. J. H. Beemer had a two years' option for the purchase of the Quebec Street Railway. It is now said to be his intention to purchase the road, and to consolidate it with the Quebec, Montmorency and Charlevoix Railway. The motive power of the latter road will at once be converted from steam to electricity. Later on the extension of the Quebec, Montmorency and Charlevoix will be made to Murray Bay.

Mr. A. H. St. Germain gives some particulars of the proposed autocar service to be established this summer between Toronto and Richmond Hill. The initial car will be a passenger and parcel van, capable of receiving 25 passengers. It will be fitted with electric light and buttons for use of conductor and passengers, by which warning may be given the motorman to turn to the right or left. Mr. Germain claims that the car will develop sufficient power to ascend the heavy grades between Toronto and Richmond Hill, at a speed varying from 6 to 12 miles per hour, carrying a full complement of passengers. The electrical equipment is the invention of Mr. W. J. Still, mechanical engineer.

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ELECTRICAL NEWS
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STEAM ENGINEERING JOURNAL.

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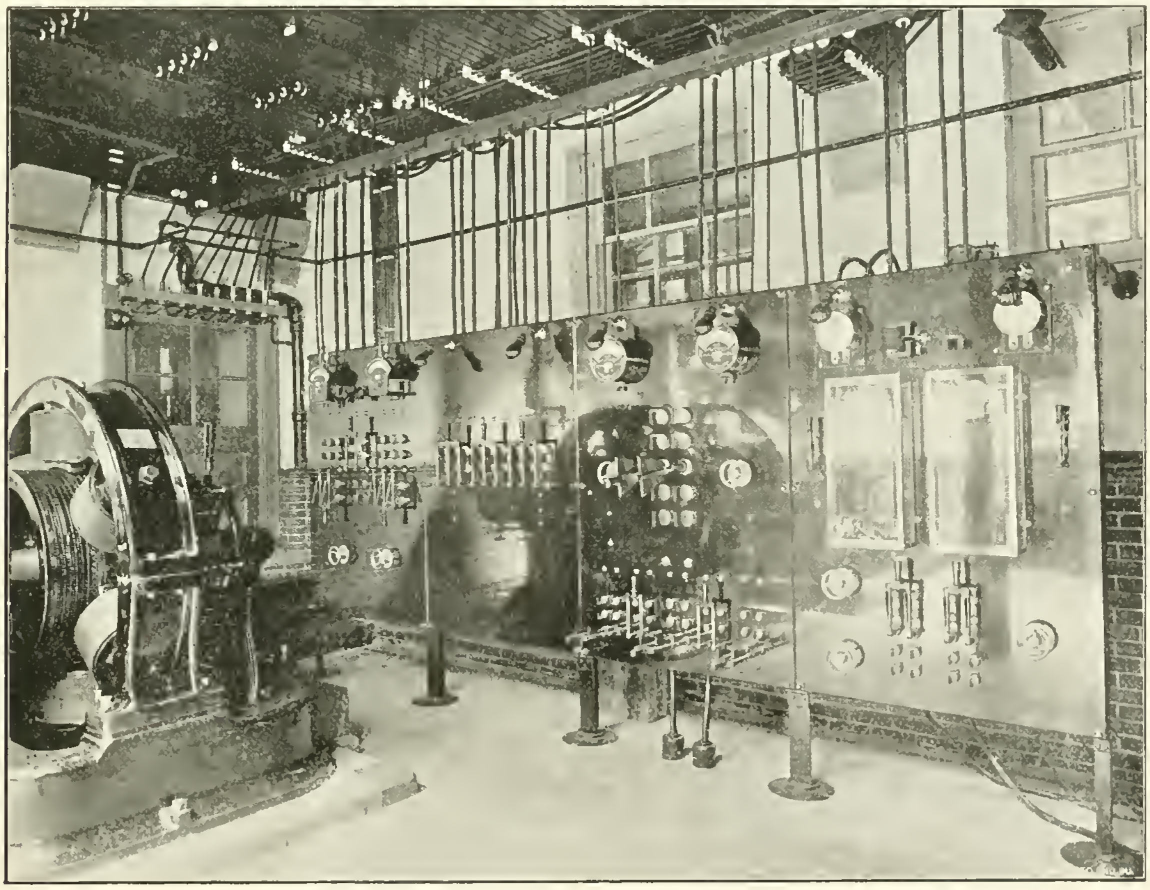
ELECTRICAL PLANT OF MACDONALD ENGINEERING BUILDING, McGILL UNIVERSITY, MONTREAL.

The lighting and power electric station of McGill University, Montreal, has, during the past year, undergone extensive enlargement and up-to-date alterations. The dynamo room is located in the basement floor of the Workman Technical Building, beside the boiler plant. The room is 36 ft. by 34 ft., with stone walls, covered by coats of cement. The floor is of Mosaique, presenting a well-finished appearance.


Electrical Plant at McGill University.—View of Switchboard.

GENERATING PLANT.

The equipment of the generating plant comprises a 35 k.w. Edison-Hopkinson dynamo, direct coupled to a high speed Willans engine; a 35 k.w. Siemens dynamo, also driven by a Willans engine, and a 75 k.w. multipolar General Electric generator, driven by a 100 h.p. Goldie & McCulloch horizontal engine. Space is reserved in the dynamo room for doubling the present capacity of the station. Beside this, two sets of storage batteries of 55 cells each, of the Crompton-Howell type, 800 amperes-hour capacity, render useful service in lighting the buildings at night or on holidays. A 5 k.w. motor generator (Lundell) is used as a booster for charging these batteries.

FOUNDATIONS.

The foundations for engines and generators are substantially constructed. The floor rests on bed rock, upon which is placed 18 inches of concrete, two ply of tar paper and asphalt, then again six inches of concrete, and one inch thick of Mosaique pavement. The foundations for the 75 k.w. generator are carried 6 feet below the floor level; the rock was picked out and solid concrete masonry put in place; 1½ in. bolts are sunk 3 feet deep in best cement concrete. The foundations above the engine room floor are made of enamelled bricks placed on edge, with corners of dark red marble. Those for the Willans engines and generators were simply laid on the rock, the facing above the level of the room being of light color enamelled brick, with corners of marble.

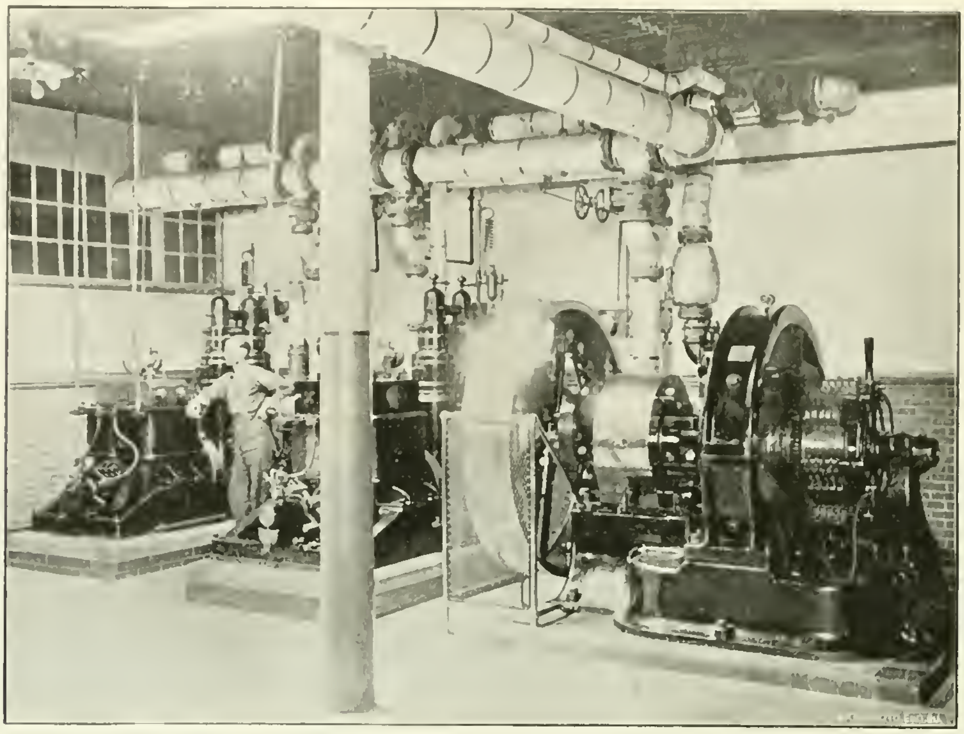
THE SWITCHBOARD.

The switchboard, as shown herewith, is 16 ft. long by 8 ft. high, and supported on pedestals 18 ft. above the floor. The board is of polished black enamelled slate 2 inches thick, made up in four panels, viz.: The lighting generators panel, the distribution panel, the power panel, and the storage battery panel. As this board will sometimes be left to the care of inexperienced people, it is so arranged that no harm can be done to the machines or apparatus by improper handling.

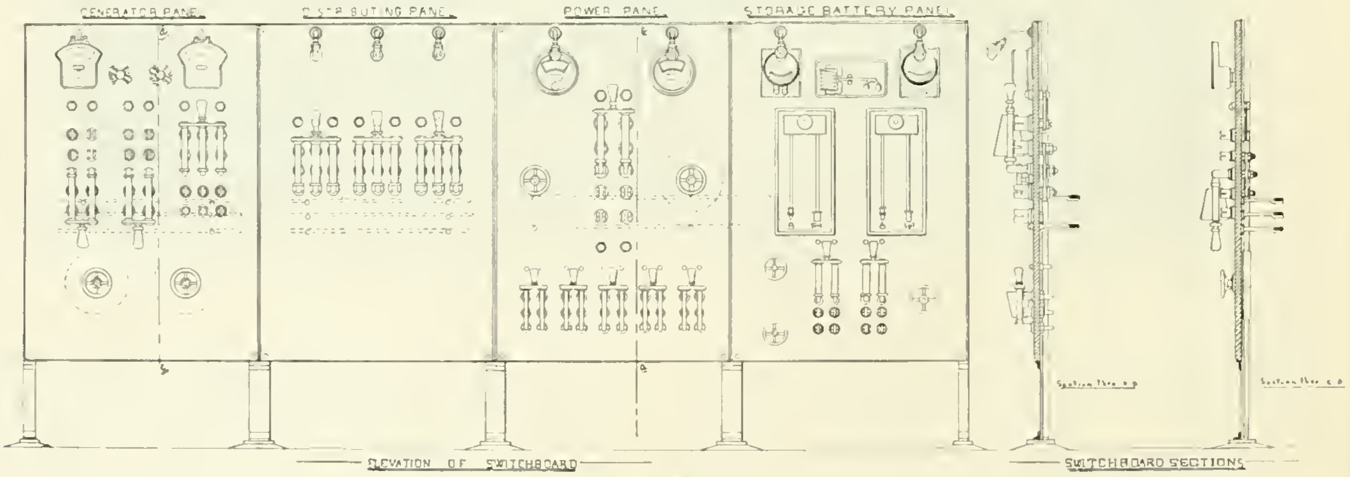
The lighting panels are so arranged that the buildings, containing three thousand lights, can be lighted by the two 35 k.w. dynamos in series, or, if the load is light, by one of them running on the two-wire system, or by accumulators.

The power panel is fed from the multipolar General Electric generator, at 125 volts, there being a separate switch for each distinct power service.

The storage battery panel enables the two sets of batteries to be charged in multiple ; there is an automatic circuit breaker, and Aaron watt meters to measure the charges and discharges from the batteries. Each machine possesses its amperemeter and voltmeter, and Thomson recording wattmeters are placed behind the board to measure the power demanded by each university building. Carpenter enamelled rheostats are used



Electrical Plant at McGill University.—View of Generating Room.



Electrical Plant at McGill University.

THE LIGHTING SYSTEM.

The buildings receiving light and power from this plant are the following : The MacDonald Engineering Building, the Workman Technical Building, the MacDonald Physics Building, the MacDonald Chemistry and Mining Building, and the Observatory. The lighting is obtained by the combination of arc and incandescent lamps. The large laboratories and testing rooms, together with the foundry and the forge, are lighted by General Electric enclosed arc lamps and long-burning lamps of different makes.

There are at present a dozen of these lamps installed. The total number of incandescent lamps is approximately 3,000. The feeders for lighting and for power are entirely separate and distinct. The motors, with the exception of fan motors, are not allowed to be placed on the lighting mains, while the general arrangement of the feeder system for light and power is such that each building has entirely separate sets of conductors from the switchboard. The going-out feeders are carried through a vertical recess, built over the switchboard, leading to the roof of the dynamo room. These, fourteen in number, are led to the different buildings on iron brackets and steel poles. In entering the buildings the feeders are run in iron-armoured conduit to main switches, so as to be able to cut out the buildings entirely from the mains.

THE MOTOR SYSTEM.

The motors used for driving the various classes of machinery in the different buildings vary in size from 1 to 25 h.p. In the Engineering building electric motors are made to drive pumps, crushing machines, elevators, fans and shafting of all kinds, for ordinary work and experimental purposes.

In the Mining and Chemistry building the entire equipment of machinery is driven by electric motors. In the Physics building a battery of storage cells, for experimental purposes, is charged from a motor-generator. Electric motors are also in use to run fans and machines of different kinds. The total horse power in electric motors is estimated at 135 h.p.

The Engineering building, the Workman building and Physics building are wired on the three-wire system. The Mining building is of the ordinary two-wire system. When the load is light, i.e., during the day, the multipolar 75 k.w. is run alone to supply both light and power to the buildings. The pressure for the motors is 125 volts, but this is reduced for the lights to 105 volts through a dimmer. When the load for light exceeds 50 amperes, the lighting load is thrown on one of the Willans engines running on the two-wire, or with the two Willans running on the three wires.

The motors are all stopped at five o'clock, the multipolar generator being then available for lighting purposes. If, therefore, the load has exceeded the capacity of the two Willans engines, either one of the buildings can be thrown on this new machine. The plant has now been in operation one year, and has given entire satisfaction.

Mr. L. A. Herdt, E.E., Ma.E.

The total capacity of engine is 200 h.p.; of generators, 145 k.w. The rated capacity of all motors installed is 135 h.p., and there are 3,000 incandescent lamps put up and a dozen arc lamps. During this time the load at the switchboard has been approximately 50 h.p. during day-time, increasing to a maximum of 100 h.p. from 4.30 to 6.30 p.m.; at that time the batteries are thrown in. The two batteries are placed in parallel when the demand exceeds 100 amperes. If the load is very light, one battery alone is placed in circuit, but an electro-magnetic device will put in circuit the other battery if the first should show signs of being discharged or of failing to do the work. These batteries, situated in a well-ventilated room beside the dynamo room, have been in operation for the last five years, and though some difficulty was experienced with them at the start, they are now working very satisfactorily. Daily records of power produced are taken; this is recorded by wattmeters placed in circuit both on the machines and batteries. It is impossible, however, to determine the actual consumption of the plant, for the same boilers provide steam for other purposes than that of the lighting plant. A large amount of electric power is also absorbed by experimental work done in the electrical laboratories and experimental dynamo room.

L. A. HERDT, E.E., MA.E.

The total electrical plant was designed and all the details of the engineering drawn up by L. A. Herdt, E.E., Ma.E., Lecturer in Electrical Engineering, McGill University, and under his supervision the equipment was installed.

Mr. Herdt, a portrait of whom we present, graduated in the mechanical engineering course, with honors, in 1893. He was laboratory assistant in the Laboratoire Central d'Electricite, Paris, and then took a course in electrical engineering at the Electro-Technical Institute, Montefiore, Liege, Belgium, taking the degree of E. E. with highest honors. In September, 1894, he was appointed assistant chief electrical engineer to the Thomson-Houston International Company, and one year later accepted the position of demonstrator of electrical engineering at McGill University, with charge of the electric light plant. In the succeeding year he was appointed lecturer in electrical engineering. During the summer holidays he is engaged in consulting engineering work. The degree of Master of Engineering was conferred upon him at the last McGill University convocation.

OTTAWA ELECTRICAL ASSOCIATION.

A couple of informal meetings have been held by a number of Ottawa electricians for the purpose of forming an association which will be of interest technically and socially to those engaged in electrical pursuits in and about the city of Ottawa. A committee, with Mr. B. Nolan as chairman and Mr. E. O'Reilly secretary, has been appointed to draft a constitution and by-laws and report to another general meeting, at which officers for the Ottawa Electrical Association will be elected. It is the intention of the prime movers in this matter to complete all preliminary arrangements during the coming summer and to start work in earnest early next fall. The reading of papers, lectures by prominent electricians, and discussions on current topics, intermingled with social features, comprise the proposed programme for next winter. The mutual advancement of members will not be lost sight of, and a proposition to incorporate a beneficiary clause in the constitution will be dealt with at the next meeting.

The Laurentide Pulp Company, of Grand Mere, Que., have ordered two 55 kilowatt direct connected generators from the Canadian General Electric Company.

The Brantford city council has invited tenders for lighting the city by 120 arc lights of 2,000 candle power and 80 incandescent lamps of 32 candle power, and also for furnishing a municipal plant.

The Cataract Power Company have made a proposition to the city of Hamilton to pump the water supply by electricity. The city engineer has reported against the acceptance of the offer, but the council has decided to engage an expert to report on the relative cost of steam and electric power for pumping purposes.

The Electric Reduction Co., of Buckingham, Que., have ordered from the Canadian General Electric Company a 1000 h.p. three-phase revolving field generator. This machine is of the same general type as those supplied for Lachine and West Kootenay, except that it is wound for the very low potential of 75 volts. It will be direct connected to the jack shaft, running at 165 revolutions per minute, and will be by far the largest generator now in use in Canada for electrolytic purposes.

THE COMPARATIVE ADVANTAGES OF STEAM AND WATER POWER.

By "Economy."

Now that the attention of the public is being closely directed to the possible utilization of the many valuable water powers which we have in Canada, it may be of interest and advantage to consider their value in comparison with the best known alternative method of generating energy, viz., by steam. The practical side of the question may almost be neglected, because modern science has so improved hydraulic machinery that the best classes of water wheels may be placed about on a par with steam engines as regards regularity of service and general satisfactoriness. The main interest will center in the commercial features of the comparison—and might take the form of the question, "Under what circumstances is water power a more economical prime mover than a steam engine?" which leads to the next question, "Can there be conditions which will cause steam power to be more economical than water power?" Both steam and water power, in what may be called their "raw" state, must be rendered available for use by more or less expansive processes, including in many cases the transmission of the energy from the point of production to the point of utilization; and it will be evident that there may be many conditions, physical and commercial, which may have considerable effect in modifying the value of one form of energy in comparison with the other.

Our rivers and steams are most of them short, and the country through which they run being denuded rapidly of forests. Hence they are very sensitive to the precipitation and respond very rapidly to it, being swollen shortly after rains, and carrying off large volumes of water in a short space of time. Similarly, after a period of dry weather they shrink to sometimes a very small proportion of their maximum flow. Even those streams which rise in marshy localities which absorb and retain moisture better, largely depend on the character of the fall weather. Should there be a considerable snowfall before the severe cold sets in to freeze the ground, then the stream will keep a more steady, even flow during the winter than it will if the hard frost sets in before the snow. And if the somewhat exceptional condition be met with of a dry summer, with little precipitation, followed by an early and severe frost without snow until late in the fall, then it is probable that many streams would dry up almost completely for several weeks, if not months. Water, therefore, as a source of power, can not be considered always satisfactory in point of reliability, unless some means can be taken for averaging up the flow; storing up the excess in times of flood, and letting it go in times of low water. This expedient is well recognized and frequently adopted; but the expense of the storage reservoirs is likely to be so great that only peculiar commercial conditions would justify it. The cost of development of a water power also is an item that may become very serious. It is but seldom that the favorable condition is found of plenty water and a large direct fall. As a rule the large streams, particularly in Ontario, have a somewhat slow current, and a high head could be obtained only by carrying the water in a long canal, which would cost heavily.

It is therefore evident that, taking everything into consideration, the first cost of a water power plant to render available a certain definite, continuous horse power, depends on the cost of machinery, dams, and perhaps storage reservoirs. If the power required does not exceed the minimum flow, then the reservoirs are not required; but they will be if the average flow is necessary. Hence it is quite possible that the total first cost of a water power enterprise, including the wheels, may be even largely in excess of the total first cost of a steam plant of the same horse power capacity. In fact, unless the circumstances be altogether exceptional, it is not likely that water first cost will compare at all favorably with steam first cost. After the first cost of the two systems comes in a very important consideration—purely commercial in its character. Manufacturing establishments using power require transporting facilities for their raw material, and for their finished product; and just in proportion as these are bulky or heavy, so does the cost of their transport become a more potent factor in deciding whether cheap power or low freight is of greater importance. More especially is this so in establishments that do a principally foreign trade, and hence require convenient access to a sea or lake port. It is a somewhat unfortunate circumstance, but in the nature of things, that the largest commercial and transporting centers are far from any considerable and swift streams. We all know of the observant traveller who remarked on the peculiar coincidence that there was always a navigable stream close to a large manufacturing city, and therein lies the answer to the question why cities are not near water powers; because navigable waters are very generally of greater importance than very inexpensive power. Hence the value of a water power largely depends on its position with regard to railways, canals, or navigable streams. Here, however, comes the very important fact that we have several distinct means of transmitting power over considerable distances; so that although the best place for generating hydraulic power may be distant from the most convenient shipping point, the intervening space may be bridged. Readers of the News are, of course, more especially interested in the electrical transmission of energy, so only that method will be considered.

Power laid down in form convenient for use at any particular spot costs money to develop, and more money to operate; and whether steam or water power is the better for any particular case can only be arrived at after careful estimate of their respective total costs per year. These total costs may be divided into fixed and variable expenses. Among the former are interest on money invested, maintenance and depreciation, insurance, wages, and the like; among the latter are fuel, oil, and the like. Every enterprise is expected to pay a fair rate of interest on the investment; most have some bonded indebtedness which is a first charge on income, and therefore interest on investment is a fair charge in making the comparison. No machinery, building, construction, or apparatus of any kind can be expected to last forever, so that estimating its life at whatever length may be proper in the light of experience, it is only sound business to lay by every year out of the gross income a sum equal to the yearly deterioration in value, so that at the end of the plant's useful life it may be found to have paid back the money invested in it. This yearly sum may be expressed in terms of a percentage of the total cost, the actual percentage varying with the class of construction or apparatus. A sum must always be allowed for maintenance, repairs, &c., and for insurance, and the wage account is always a very considerable proportion of the expenses of operation. All the above items can be calculated very closely, and placed at a pretty accurate yearly sum. Variable expenses can also be estimated sufficiently close for purposes of estimate. This is an expense which is saved in water power enterprises for the most part, and as fuel is generally one of the larger expenses, the great advantage of water comes in here. To compare the above item by item: Whether steam or water power be used, the interest percentage will be the same, so that the respective charges on this account depend entirely and solely on the respective costs of the two methods. If the whole hydraulic construction be more expensive than the equivalent steam plant, then the hydraulic interest charge will be greater than steam interest charge, and similarly. This requires a mere comparison of estimates of investment. In the depreciation account this equality is not preserved. The hydraulic plant will probably be far more durable than the equivalent steam plant. The dams will last all the longer as they are more solidly built, and a small sum spent yearly in inspection and repairs will cause them to last indefinitely. Besides which a "second hand" dam and water privilege is just as valuable as one brand new, if it has been properly maintained, which cannot be said for a second hand steam plant. Probably a fair depreciation on the whole dam, gates, tail race, &c., can be placed at 2%. Of the hydraulic plant, wheels, regulators, shafting, &c., a reasonable life of 25 years may be expected, with the consequent depreciation percentage of 4%; building 2%, if of solid brick or masonry construction. The insurance charge will be considerably less in a hydraulic than in a steam plant, and will be smaller as the building is less fireproof. It must also be remembered that the first cost of the hydraulic building will very probably be quite appreciably less than that of the steam building.

The same items in a steam plant may be reasonably taken at: For boilers, a life of 10 to 15 years, depreciation percentage, 10%; engines, shafting, journals, piping, 20 years, percentage 5%; insurance probably 25 cents per $100 higher than with water. As to the wages charge, it is probable that a hydraulic plant can be operated just as efficiently as a steam plant, with fewer men, and consequently smaller wages expense. The larger the plants the better for the hydraulic, for while one man cannot properly attend to more than so many boilers and keep good steam, owing to the work increasing as the battery is large, the additional size or number of water wheels imposes no greater work on the operators. It may be fairly pointed out that there are labor-saving devices, such as automatic stokers, which increase the work efficiency of the firemen very greatly, enabling one man to keep good steam on a number of boilers, but at the same time it is wise to remember that all such devices increase the complexity of a steam plant, raise the probability of accident, and render advisable the employment of higher class engineers at greater expense. In plants of a certain capacity it is necessary to employ both engineer and fireman, one man not being sufficient. In a water power one man would be quite capable of looking after the entire plant, hence the other man's wages are saved; and one superior mechanic can do the work of two and save considerable. The great importance of this item will be evident when it is considered that the saving of $1 per day or $300 per year (about the usual wages of a fireman) will pay the interest at 5% on $6,000. This means that a water power plant may cost $6,000 more than a steam plant of equal size, and be an equally good investment, if thereby one fireman's wages can be saved.

The most important item among the variable expenses is undoubtedly the fuel, which will vary very greatly according to locality, kind of business, state of markets, etc. In coal mining localities refuse can be obtained for almost nothing—for the expense perhaps of carting it from the pile; in others good steam coal costs as high as $6, $7 or $8 per ton. Wood varies according to locality from 75 cents to $2.50 a cord. Oil or gas fuel can be obtained in certain favored localities. It is of course obvious that as fuel—whether coal, wood, oil or gas—is less expensive, so does the value of a water power become less in comparison with that of steam. Another very important commercial consideration—coal fields are always well supplied with railroad facilities, sometimes even with canals—so that the two most important manufacturing advantages are found together: easy transport and cheap power. Nature herself seems to place obstacles in the way of hydraulic power, for just as a large stream has a greater fall along its course, so does it become more difficult for railways to follow it, owing to the grades. Hence it is generally necessary to transmit hydraulic power for some considerable distance to a convenient shipping point, and this means larger fixed charges to offset the entire elimination of the fuel charge. It is obvious that assuming a sufficiently low cost of fuel at the shipping point, and an expensive water power and transmission plant, there may easily be conditions which will make a water power of no value whatever in comparison with steam. For instance, in a recent case, to develop and render available a certain water power for use 12 hours a day for 365 days a year, required the damming of some storage lakes, and the transmission electrically of about 150 h. p., in all about $20,000. The expenses in connection with this enterprise, for interest, depreciation, wages, etc., were estimated at $2,700 per year. The cost of a steam plant to do the same service was estimated at $8,000. Now, taking the above percentages and allowing two men for the steam at $800 wages, the same expenses without fuel would come to about $1,500. Thus $1,200 are allowable for fuel in order that steam and water (electrically transmitted) may be equally good investments. This allows $8 per horse power year for fuel. Or allowing 4 lbs. of coal per h. p. h. (condensing) comes to the equivalent of 1080 tons of coal per year. Coal, or equivalent, at $1.11 per ton would make either plant an equally good investment; at $1.12 would be more expensive than water power; at $1.10 would be more economical than water.

Now, if this water power had been situated about 100 miles from where it was, and placed as near a Nova Scotian coal mine as it was to its distributing point, then culm could have been obtained at 25 cents per ton, and allowing even 4 tons of culm to give as good effects as one ton of good steam coal, even then the steam plant would have been the better investment. At the distance of 32 miles from the above coal mine, culm cost $1 laid down, so that the fuel for the above plant would have greatly exceeded the $1,200 allowed. Here we have a very clear illustration of the way in which the comparative values of steam and water power vary. At one end of a 32 mile line the water power was worth nothing at all; at the other end it would have been a good investment for $25,000.

The kind of business to be done will also largely affect the comparison. There are many products that require heat in the various processes, for bleaching, cleaning, bending, drying, and what not. In the present state of our knowledge of electrical matters, it is not wise to predict what may or may not be done in the next few years in the way of electrical heating, but we do know that water power will not develop heat without its transformation into electrical energy; so that unless this transformation is made, a water power plant will have to be supplemented by a steam heating plant in all cases where heat is required. If not a steam heating, then hot air, stoves, &c., which all mean fuel.

Now, if steam is to be used at all, it might just as well be used as economically as possible, and to raise steam to a high pressure costs less proportionally than it does to generate a low pressure. If, therefore, high pressure steam be used in steam engines, and their exhaust be availed of for drying or heating purposes, it might very well be that the expense incurred would compare very favorably with the total interest and other expenses of a combined water power and steam heating plant. And the comparison would be all the more favorable to steam as steam became necessary in larger quantities for drying and less comparatively for power. There are other industries again which necessarily produce combustible refuse, which they must consume in some way, such as tanneries, planing and saw mills, and other wood working industries. Unless they have some local demand for such refuse it becomes very necessary to burn it up to get it out of the way. In all such cases it is questionable whether water power would have any value at all.

In appraising the comparative values, therefore, of a water privilege in relation to steam working, it becomes necessary to regard the whole question from a strictly commercial standpoint. The total first cost by the two methods must be reliably estimated, with their probable maintenance and operating costs. Due consideration must be given to the cost of extra haulage and handling, where the water power is not on the transport line, and be debited against it. The heating problem is a factor, and the cost of fuel, and if the careful discussion of the matter leads to the result that steam is the more economical, then no arguments based on the "sin of wasting power at our doors" should be allowed to influence it. It is obvious that no particular rules can be laid down by the application of which the value of water power can be determined from tables like a logarithm. Every case must be determined on its merits, and the above illustration showing how the merits may vary widely in 32 miles, serves to emphasize the importance of careful investigation and logical calculation.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	A.M. 12.40	A.M. 3.40	3.00
2....	No Light.	No Light.	.....
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	No Light.	No Light.	.....
6....	P.M. 7.50	P.M. 10.50	3.00
7....	" 7.50	" 11.30	3.40
8....	" 7.50	A.M. 12.30	4.40
9....	" 7.50	" 12.50	5.00
10....	" 7.50	" 1.00	5.10
11....	" 7.50	" 1.20	5.30
12....	" 7.50	" 1.50	6.00
13....	" 8.00	" 2.20	6.20
14....	" 8.00	" 2.50	6.50
15....	" 8.00	" 3.20	7.20
16....	" 8.00	" 3.30	7.30
17....	" 8.00	" 3.30	7.30
18....	" 8.00	" 3.30	7.30
19....	" 8.00	" 3.30	7.30
20....	" 8.00	" 3 30	7.30
21....	" 8.20	" 3.30	7.10
22....	" 8.40	" 3.30	6.50
23....	" 9.10	" 3.30	6.20
24....	" 9.40	" 3.30	5.50
25 ...	" 10.00	" 3.30	5.30
26....	" 10.30	" 3.30	5.00
27....	" 10.50	" 3.30	4.40
28....	" 11.00	" 3.30	4.30
29....	" 11.30	" 3.40	4.10
30....	" 11.50	" 3.40	3.50
......	....	....	.....
		Total......	147.50

Some of the ratepayers of Springhill, N. S., favor the purchase by the town of the electric light plant. The price now paid is $20 per light for 28 lights for a part night service.

The Canadian Motor Syndicate is looking for a site for a factory, the purpose being to manufacture motor vehicles. This is the company in which Mr. A. H. St. Germain is interested.

The Coaticook, Que., Electric Light Company has elected the following directors: President and treasurer, H. Lovell; secretary, W. L. Shurtleff; managing director, F. E. Lovell; P. T. Baldwin, J. H. Morgan and W. L. Shurtleff. A semi-annual dividend of 3 per cent. was declared.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

The Toronto Technical School has just closed a very successful term, the classes being largely attended. In the "Electricity" and "Steam" courses (Mr. Harris P. Elliott, B. A. Sc., Lecturer) the following students successfully passed their examination :

Junior Electricity—Class I. M. Watts and I. F. Jackson (equal) ; A. J. Watkins and W. A. Ratcliffe (equal) ; D. T. Brown, H. Hargreave ; R. Yeomans and H. J. Lillie (equal) ; G. H. Pargeter and W. K. Greenwood (equal). Class II.—A. H. McBride, H. B. Jewett, A. A. Strathdee ; C. W. Moir and T. C. McAree (equal) ; H. Buck and T. S. Buck (equal). Class III.—R. G. Archer, J. Stevenson.

Senior Electricity—Class I.—Alex. Gerry, T. Brown; John A. Whyte and J. E. B. Hancock (equal). Class II.—G. H. Robinson. Class III.—W. K. Greenwood, S. J. Evason, K. A. McKae.

Steam and Steam Engine (junior). Class I.—Alex. Gerry and J. B. Hancock (equal). Class II.—D. T. Brown, John A. Whyte. Class III.—T. Steels, R. Quinn, T. C. McAree, G. D. Bly.

Steam and Steam Engine (senior). Alex. Gerry, T. C. McAree.

Below will be found a copy of the examination papers in the above subjects :

ELECTRICITY AND MAGNETISM.

1. Define : Magnet, Consequent Poles, Magnetic Induction, and give the Laws of Magnetism.

2. What is the nature of the so-called lines of force? What do they represent? How would you determine their presence and direction?

3. Two bar magnets are placed on a table with their north poles pointing towards each other and about 1½" apart. A sheet of glass is placed over these and iron filings are sprinkled upon it. Show how these arrange themselves, and explain clearly why they do so.

4. What are the essential parts of a voltaic cell? What is polarization? Describe any single fluid and any double fluid cells which do not polarize.

5. Give several methods of showing the presence of a current in a wire. How could you determine its direction?

6. Two copper plates of equal weights are placed in a solution of copper sulphate and a current of 5 amperes is passed through from one end to the other for 10 hours. What is then the difference in weight? Electro chemical equivalent of copper 0.0003261.

7. If the plates in the previous question were of platinum, describe exactly what would take place if the current were passed through as long as possible. What would stop it?

8. Describe any form of galvanometer. What points in its construction make it sensitive?

9. What is meant by self-induction? Show how it affects the action of the induction coil and how this effect is partly got rid of by the use of a condenser.

10. State Ohm's law. Explain it fully.

11. Twelve incandescent lamps, each having a resistance of 200 ohms, are put in series across the terminals of a 500 volt circuit. What current passes?

12. What is the best method of grouping 12 cells, each having a resistance of 3 ohms and an E.M.F. of 2 volts, in order to get the greatest possible current through a lamp whose resistance is 4 ohms. What is the current?

13. Twenty pounds of copper is made into a wire 1,000 feet long, having a resistance of 1.5 ohms. If it had been made into a wire 2,000 feet long, what would have been its resistance?

14. Three wires have resistances of 5, 10 and 15 ohms, what is the combined resistance in series and in parallel?

15. Describe any method of measuring resistance.

16. Describe a simple telegraphic circuit, showing the instruments and how connected.

17. Give a diagram showing the connections on an induction coil.

18. Describe any form of telephone transmitter and receiver.

SENIOR ELECTRICITY.

1. Name various methods of producing Electricity. Why is the method of induction so important?

2. Describe briefly how to demonstrate the laws of induced currents by means of the following apparatus : A galvanometer, two coils of wire, a battery, a bar magnet and a bar of soft iron.

3. In all cases of electro-magnetic induction the induced currents have such a direction that their reaction tends to stop the motion which produces them. A current flowing contra clockwise produces a north pole, and the lines of force are considered to be proceeding from a north pole. From the above facts deduce a rule similar to Fleming's.

4. Upon what does the E.M.F. of a dynamo depend? Deduce the rule

$$E = \frac{N.C.n.}{10^8}$$

5. Explain the cause of sparking at the brushes of a dynamo. How does shifting the brushes prevent it? When is it impossible to prevent it by this means?

6. Why does a shunt-wound dynamo not give a constant voltage? What arrangement is used to make it do so?

7. Give a practical method of determining the number of series turns required to compound a given dynamo.

7. Obtain the formula for the efficiency of a shunt dynamo in the form

$$\text{Efficiency} = \frac{C\ A}{(B+C)\ (A+B+C)}$$

$\frac{1}{B}$ = Shunt resistance.

$\frac{1}{C}$ = External resistance.

$\frac{1}{A}$ = Armature resistance.

9. Explain : Friction, Hysteresis and Eddy current losses. What point in construction reduces the latter to a minimum?

10. An iron ring has a cross-section 10 square C. M. and a diameter of 20 C.M. We wish to send around it 120,000 lines of force. How many ampere turns must be provided?

$$\frac{B}{H} = 1000$$

11. Give any method of measuring resistances.

12. Several of the wires in a lead-covered telephone cable are found to be grounded. How will you determine the position of the fault?

13. Why does weakening the field of a shunt motor cause it to run faster? How is it that a shunt motor supplied with current at a nearly constant voltage can be made to run at a nearly constant speed?

14. Describe any form of electric meter, mentioning its good points and also its defects.

15. What is the external characteristic of a shunt-wound dynamo? Make a diagram showing how apparatus could be arranged to get the characteristic of a small Edison machine wound for 110 volts.

STEAM AND STEAM ENGINE (SENIOR.)

1. Define : Super saturated, saturated, and super heated steam, total heat, heat of the liquid and heat of vaporization.

2. A boiler was found to evaporate 15,000 pounds in a 10 hours' run. The feed water was raised to a temperature of 200° F. by means of the exhaust. The average gauge pressure was 85 pounds. Find the equivalent evaporation from and at 212°.

3. What is meant by a standard boiler horse power? In the previous question what standard B.H.P. was developed?

4. How does the production of wet steam affect the efficiency of a boiler?

5. Describe any modern type of water tube boiler, and name some of the advantages claimed for it.

6. Give rough sketches of various water tube boilers to show the arrangement of the parts ; indicate by arrows the direction of the water circulation and of the hot gases. Show the position of the feed water pipe.

7. A marine boiler is to be 20' in diameter, and to withstand an internal pressure of 125 pounds per square inch, allowing a factor of safety of 4 and a tensile strength of 60,000. What material would you use and what thickness, assuming that the ends are stayed and made as strong as the shell?

8. An engine is to cut off at ¾ stroke, to have a maximum port opening of ⅝" and lead of ⅛". The exhaust is to open at 90% of the stroke. Show how to find the inside and outside lap of the slide valve, the throw and the advance angle of the eccentric.

9. How would you set the slide valve in the above engine to give it an equal lead at both ends? How would you set it to get twice the lead at the head end as at the other?

10. Draw a card such as might be taken from a Corliss engine, and explain how to determine from it the steam used per I.H.P. per hour.

11. Explain fully the effect of condensation by the cylinder walls on the efficiency of an engine. What methods are used to reduce this effect?

12. Define Work, Power, Horse Power. A hoist is to elevate one ton (2,000 lbs.) of coal 50 feet high in 3 minutes. What horse power is required?

13. If you know the dimensions, speed, valve motion and working steam pressure of a given engine, how will you compute its probable I.H.P.?

14. Two exactly similar locomotives are put on a level track and made to pull against each other. They stand still with their wheels revolving at the rate of 300 R.P.M. The drivers are 6' in diameter and a spring which is used to couple the engines shows that they pull against each other with a force of 1,500 pounds. Find what horse power is being developed by each.

John A. Coryell, C.E., Midway, B. C., has been making surveys for the proposed utilization of the water power of the Kettle river at Cascade Falls. Quite lately the Cascade Development Company disposed of their rights in the water power to an English syndicate, which is represented by C. K. Milbourne, Nelson, B.C., and for them the work has been done. A large power plant is projected.

THE MARITIME ELECTRICAL ASSOCIATION.

A Maritime Electrical Association was duly organized at a meeting held at the Halifax Hotel, Halifax, N. S., on the 12th of April. There was a good attendance and all seemed to realize the need of such an association and were unanimous in their support of what had been done. A constitution was adopted, and the following officers were elected :

President, F. A. Bowman, New Glasgow, N. S.; Vice-President, H. Colpitt, city electrician, Halifax, N. S.; Secretary-Treasurer, J. H. Winfield, local manager Nova Scotia Telephone Co., Ltd., New Glasgow, N.S., also a representative executive committee from the three provinces.

It was decided to hold the first regular convention in Halifax some time in September.

We have the privilege to present to readers of the Electrical News brief personal sketches and portraits of the executive officers, under whose experienced guidance the new organization may be expected to prosper, and prove of much advantage in advancing the welfare of the electrical industry in the provinces by the sea.

MR. FRED. A. BOWMAM, M.A., B.E.,

President of the new association, is a native of Nova Scotia, having been born at Windsor, and has had a varied and valuable experience in engineering and electrical work. He is a graduate in arts and mining engineering at King's College, in his native town, and worked a couple of years at mining and kindred work. He was afterwards employed in the locomotive shops of the I. C. R. and in the office of E. Vassnack, M. E., Halifax. He subsequently took the expert course at the Thomson-Houston Works at Lynn, Mass., and also held a position with the New York office of the same company. Mr. Bowman spent a year in the employ of the Royal Electric Company of Montreal. Since 1892 he has occupied the position of superintendent of the New Glasgow Electric Light Co., Limited, of New Glasgow, N. S. Mr. Bowman is an associate member of the Canadian Society of Civil Engineers, and a member of the American Institute of Electrical Engineers.

Mr. Fred. A. Bowman, M.A., B.E.,
President Maritime Electrical Association.

MR. H. COLPITT,

Vice-President, was born at Forest Glen, New Brunswick, in 1861. Immediately after leaving school a few years were spent on the road as a commercial traveller. He entered the employ of the Halifax Electric Light Company shortly after the inception of electric lighting in the maritime provinces. When the company was sold out to the gas company Mr. Colpitt's services were retained, and after two years he was appointed superintendent of the electric lighting plant. This position he held until 1897, when he received the appointment of city electrician for Halifax. Mr. Colpitt, although quite a young man, is entitled to be regarded as one of the veterans of the electric light business, having had an experience therein extending over thirteen years.

Mr. H. Colpitt,
Vice-President Maritime Electrical Association.

MR. J. H. WINFIELD,

Secretary-Treasurer, is a native of Derby, England, and was educated in London. He took the electrical engineering course at Peoples' Palace, and received a good mechanical training in the shops of Hammersley Bros., scientific instrument makers, Barnsbury, London. In the fall of 1891 he came to Nova Scotia and accepted a position in the Halifax office of the Nova Scotia Telephone Co., Ltd. In March, 1893, he was transferred to New Glasgow, to take charge of the company's exchange there. In October he was made superintendent of their eastern division, with headquarters at New Glasgow, which position he still retains.

Mr. J. H. Winfield,
Secretary-Treasurer Maritime Electrical Association.

Sixteen thousand dollars is said to be the record price paid for a cablegram, that price having been paid for a message sent by Heniker Heaton to Australia in behalf of the British Parliament.

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AND
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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers' Hall, 61 Victoria street. G. C. Mooring, President; T. Eversfield, Vice-President; J. W. Marr, Recording Secretary.

TORONTO BRANCH NO 2.—President, John Dixon; Vice-President, John H. Venables; Recording Secretary, Thos. Graham, 570 King street west.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers' Hall, Craig street. President, Wm. Smyth; 1st Vice-President, Wm. Bowden; 2nd Vice-President, P. McNaugton; Recording Secretary, J. O'Rourke; Treasurer, G. Jones.

ST. LAURENT BRANCH NO. 2.—Meets every Monday evening at 43 Bonsecours street, Montreal. R. Drouin, President; Alfred Latour, Secretary, 306 Delisle street, St. Cunegonde.

BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

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WINNIPEG BRANCH NO. 11. President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO 12 Meets every Tuesday at 8 o'clock, in McKibbon's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO. 14. Meets 2nd and 4th Wednesday in each month W. L. Outhwaite, President; W Forster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, John Grundy; Vice-President, C. L. Bertrand; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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Information regarding examinations will be furnished on application to any member of the Board.

Employment of Competent Electricians.

IT occasionally happens that a slight defect in some part of an electrical plant, which could probably be remedied in the simplest possible manner, results in the condemnation of the entire machinery, owing to lack of knowledge on the part of the person in charge of the plant. It is not unusual to hear of the manufacturers being called in to adjust some difficulty, only to find that the trouble was of the most trifling nature, and such as should have been readily ascertained and put right by the electrician. The cause of such a condition of affairs is frequently to be found in the low salaries paid to superintendents and operatives. These salaries offer no inducement to competent men, possessing the knowledge requisite for the efficient operation of an electric light plant, and hence the engineer with a smattering of electrical education is employed to do the work. It is not to be wondered at that so many so-called breakdowns occur. It is false economy to buy an up-to-date plant and place an inexperienced person in charge. This fact is rapidly becoming recognized, and the result will be a greater demand for properly qualified electricians.

Canadian Electrical Association.

As the date for the annual convention of the above Association at Montreal draws near, interest in the event is deepening. At the last meeting of the Executive a considerable number of new members were elected. Other applications are constantly coming in to the secretary. Each individual member of the Association should endeavor to add new members to the roll and assist in swelling the attendance, so that the coming convention shall be an unqualified success. Montreal, aside from its many other attractions as the chief city of Canada, is the point of greatest interest to persons connected with the electrical industries. The headquarters of the Bell Telephone Company's extensive system, the large manufactory and up-to-date lighting stations of the

Royal Electric Co., the electric transmission plants at Chambly and Lachine, McGill University, with its elaborate electrical and engineering departments, will all be thrown open to the inspection of the members of the Association who may attend this convention, and will in themselves be found well worth the time and expense incidental to the visit. All the arrangements for the meeting are making satisfactory progress. The Executive will meet towards the close of the present month to receive the reports of the various committees, complete all arrangements, and arrange for the immediate publication of the programme.

Cable vs. Electric Tramways.

In the Dominion of Canada cable tramways are practically unknown, but in Great Britain this method of propulsion has been adopted by some of the largest cities. The Edinburgh cable tramways were supposed to have been eminently successful, and are frequently referred to as a model system. It would seem, however, that they have not been the success which is generally supposed, as when the question of an extension was under consideration recently, several members of the city council advocated the adoption of electric traction, and the question was referred to Professor Kennedy, F.R.S., for a report. With the improvements being made in electrical apparatus, and its greater application for special purposes, electric traction promises soon to supersede all other systems.

Dangers of Acetylene.

A Woodstock, Ont., paper reports the blowing to pieces of an acetylene gas generator in that city recently. The generator had been on exhibition in the rear of a cigar store. Owing to the fact that there was very little gas in the machine at the time of the accident, no serious damage was done except to the generator itself, but the tenants of the adjoining buildings got a bad scare. Over the back door of the room in which the generator was placed an overflow pipe extended out from the building. A young man who was standing in the doorway, in raising his hand to throw down a match, ignited the overflow gas. The flame travelled quickly along the gas pipe and entered the generator, causing the explosion. But for the fact that the machine was being prepared for removal and contained little gas, the consequences might have been serious.

Efficiency of Lamps.

It is supposed that incandescent lamps, when old, take more power than when new. A lamp when new may give one-third candle per watt, and after this same lamp has been burning for about 400 hours it may give one-sixth candle per watt. Lamps, as a rule, will take less energy after burning awhile than when new, but owing to the fact that the candle decreases with the life, the power per candle is greatly increased. Therefore it is more correct to say that more power is required for a given quantity of light, and as it is light that is sold, not power, it stands to reason that when maximum candle power for minimum expenditure of power is required that lamps must be renewed about once every 350 hours. In a test recently made with several makes of lamps, where each of the various lamps started with an illuminating power of about one-third candle per watt, at the end of 300 hours some of them were only giving one-ninth candle for the same expenditure of power. Truly, there is room for improvement still in the incandescent lamp.

Car Lighting.

The lighting of railway cars is a subject which has received much attention of late from both railway companies and manufacturers of electrical machinery. Many systems have been devised, but so far none have given entire satisfaction. The equipment which has recently been placed on the sleeping car Winchester by the Canadian Pacific Railway Company probably comes nearer a solution of the problem than any other, the results produced giving promise of ultimate success. The current is generated from the axle by the motion of the train, and the surplus current is stored in a battery, which maintains regular current and provides also for stoppages. It is said that there is little flickering or irregularity in the light, although in some respects the system is not all that could be desired. That electricity will furnish the future light for railway cars is now almost certain.

Municipal Control.

As regards the advantages derived from municipal ownership and operation of public services, the New York Post, one of the ablest public journals of the United States, says: "Municipal ownership is one of those phrases which, in a certain order of mind, take the place of reasoning, investigation, common sense. It is invested with a magic, a miracle-working, power which makes anything claimed for it credible. The city gas works in Philadelphia were long the substitute for argument in the mouths of advocates of municipal ownership. But their recent abandonment, after confessed losses and scandals, has led the champions of municipal operation of the public lighting and transit services to look more and more abroad for comfort, and Glasgow is the city whence they have derived most of it. So wild have been the romances set afloat about the immense profits derived by Glasgow from its control of public franchises that the Lord Provost has been compelled to issue the following circular letter:

> "The Lord Provost of Glasgow has received communications from all parts of America desiring confirmation of a statement to the effect that the citizens of Glasgow would be free from all taxes or rates in consequence of the profits derivable from their gas, water, electric lighting, and other undertakings of the government. I have accordingly been requested by the Lord Provost to inform you that this statement has no foundation in fact. There is no probability of this city being exempt from taxation.
>
> "John S. Samuel, City Chambers."

Thus is the socialistic millennium adjourned again. Taxes are not yet abolished, even by municipal ownership. Yet there is little doubt that if municipal ownership were given free course, it would ultimately make an end of taxes, for it would make an end of property to be taxed."

Electricity in Mexico.

It is reported that the valuable water powers which abound throughout Mexico are rapidly being taken possession of with a view to their profitable utilization. The cataract at Juanacattan is said to be second on this continent to that of Niagara. There has recently been installed an extensive plant costing $700,000 to convey electricity for power purposes from the Cascade of Regea to several mines and factories fifteen miles distant. The hydraulic force is utilized by means of Pelton water-wheels, driving five tri-phase dynamos, each of 400 h.p., one of which is kept as a reserve, and two exciters. The tension of the current, as received from the dynamo, is 700 volts, which by means of step-up transformers is increased to 10,000 volts for transmission. Three bare conducting copper wires about one-third of an inch in diameter, carry the current. The loss in transmission is stated to be only ten per cent. In view of the activity in engineering work of this character, Canadian manufacturers of electrical apparatus might profitably enquire into the possibilities of the Mexican market.

Coal Consumption. In a test made in a large institution recently, it was shown conclusively that it took 12½ lbs. coal per indicator horse power per hour. This engine was used for driving dynamos for lighting the institution. The method of driving was from engine to jack shaft and then from jack shaft to dynamos. Taking the readings with reliable volt and ampere meters, there was a loss of 40 lbs. between the engine and switchboard, showing that there was a coal consumption of 20 lbs. coal per E.H.P. at the bus. The question now arises how many more plants are there in the country taking the same coal consumption. One thing certain, this is not the only one. A plant of this kind is dear at any price, in fact it would not pay one to accept it for nothing. Let buyers of certain electric plants have certain guarantees as to the efficiency of same, and let them engage good reliable engineers to make the test to see if they have fulfilled the guarantees, and when we come to this method of doing business better results will be obtained all around.

Electrical Apparatus for Mining. Reliable reports from British Columbia state that the development of the gold mines in that province is being steadily proceeded with, and that there is more machinery being purchased than ever before. There is being employed a large quantity of electrical apparatus for the operation of hoists, drills, etc., and light and power companies now installing plants report the outlook for business as very promising, one favorable feature being that the demand is chiefly for large units, usually above fifty horse power. One of the largest contracts has just been closed with the proprietors of the War Eagle mine. An air compressor with a capacity of forty drills will be driven by a 300 kilowatt motor and an electric hoist by a 300 h. p. induction motor, the average working load of the hoist being eight tons. This plant is said to be the first of its kind to be used in Canada, but it will undoubtedly prove to be only the forerunner of many others, as mining development in British Columbia now seems to have reached a solid basis. There exists, we believe, the misapprehension that machinery of American manufacture is largely used in mining work. Instead of this being the case, we are informed that Canadian machinery is almost exclusively employed, and this notwithstanding that many of the mines are owned and being developed by Americans.

The work of constructing the C.P.R. telegraph line between Montreal and Vancouver was commenced on April 14th last.

The British Columbia Bullion Extracting Company, of Rossland, B. C., have ordered from the Canadian General Electric Company a 100 h.p. three phase synchronous motor and a 50 h.p. three phase induction motor to operate their works.

The Bell Telephone Company have commenced work on their new exchange in Quebec. The structure will be 30 x 88 feet, and will be built of granite, surmounted by a corniceing of red copper, and will cost over $17,000. The switchboard, which is now being made in Montreal, will accommodate 3,000 subscribers. It is expected that the new building will be ready for occupation by the month of July.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 28th of each month.

ANNUAL DINNER OF HAMILTON NO. 2.

The eleventh annual dinner of Hamilton No. 2 was held in the Commercial Hotel on Thursday, April 7th. The attendance was as large as usual, and included Messrs. Wickens, Mooring, Moseley, Fox, Eversfield, Blackgrove and Bain from Toronto No. 1, and Messrs. Dixon, Richardson, Graham and Hughes from Toronto No. 2. R. Mackie presided. The menu was excellent and received due attention, after which came the following toast list: "The Queen," responded to by the company; "Canada, Our Home," by A. Hartwell; "Mayor and Corporation," by Ald. Fernside and Pettigrew; "Manufacturers," by J. McLaughlin, Toronto; "Educational Interests," by J. S. Williams; "Executive Head," by E. J. Philip and A. M. Wickens; "Sister Associations," by G. C. Mooring and J. Dixon; "Hamilton No. 2," by R. Mackie; "The Ladies," by O. P. St. John; "Host and Hostess," by Mr. Maxey.

During the evening music was rendered by the Eolean Club, and Messrs. Dixon, Stanley, Hastings, Childs, Blackgrove, Mitchell and Maranett, Mr. J. Bain acting as accompanist. A pleasant feature of the evening was several selections on the gramophone, operated by Mr. Morrice. The banqueting committee consisted of R. Mackie, chairman; J. Ironside, secretary; P. Stott, W. K. Cornish, W. Stevens, R. C. Pettigrew and R. E. Chillman.

LONDON NO. 5.

A member of the Forest City Association, referring to the competition inaugurated by Mr. G. B. Risler, a past president, writes as follows: "Mr. D. G. Campbell, Pottersburg, president of London branch, has received the first prize of $8, and Duncan McKinley the second prize of $5. Both men are active members of the association, and their efforts are to be commended. They have not been awarded cash prizes, but the amounts are placed to their credit with the International Correspondence School of Scranton, and is to be taken out in tuition. The question papers have had the desired effect—the competitors were compelled to make themselves acquainted with arithmetic, and to reason and study—and they frankly admit that it was hard work; but on the other hand they claim it was beneficial to them, and the prizes were received with the greatest of pleasure. The examining board consisted of Messrs. Risler, Bright, Goldart and McLean. Mr. Norris, president of Hamilton branch, is now with London No. 5, having accepted a position as engineer with the London Street Railway Company, of which Mr. Potter is chief engineer and superintendent. Mr. Norris has already made himself esteemed by the members, having given some good lectures on steam engines, boilers and electricity. He received a letter of regret from Hamilton branch, at the same time congratulating him on his success. London No. 5 is doing well, reorganized Nov. 19th, 1896, with 6 members, and now we are 27 members strong. Our meetings are held on the first and third Saturday of each month, at 7.30 p.m., in Sherwood Hall."

The Philadelphia Electrical Exposition Company propose holding an electrical exhibition in Philadelphia, commencing June 6, 1898, and continuing for one month. It is expected that a number of the exhibitors at the New York exhibition will remove their goods to this exhibition.

FENELON FALLS ELECTRIC TRANSMISSION SCHEME.

A company is in process of formation for the development of the energy of Fenelon Falls, Ont., and the transmission to Lindsay of all the power that can be used in that town. The Fenelon river connects Cameron lake and Sturgeon lake, and gives a head of 24 feet at the Fenelon village, with sufficient water to render available well over 2,000 horse power in the dryest season of the year. The distance to Lindsay is nearly 16 miles, and the promoters claim that nearly 1,000 h. p. can be counted on there—not taking into account any new enterprizes that may be attracted by the cheaper power. The representatives of the company are reported to have acquired the entire control of the water power from the Smith Estate, and from Messrs. Macdougall & Brandon (who operate the Fenelon electric light plant), and have also made some important contracts in Lindsay for the supply of power, including the contract for the street lighting. It is also contemplated to energetically push the lighting business in Lindsay. The complete plans have not yet been formulated, but reports say that all machinery and apparatus will be of the highest class, and some interesting engineering features will be introduced. The engineering is in the hands of Mr. George White-Fraser, of Toronto, and the secretary pro tem is Mr. J. Alex. Culverwell.

View of Fenelon Falls.

ELECTRICAL APPARATUS FOR THE WAR EAGLE MINE.

The War Eagle Mining and Development Company, of Rossland, B. C., have closed a contract for electrical machinery to operate the new plant which they are installing at their mine. The plant in question will consist of a 40 drill Ingersoll-Sergent air compressor and a double drum mining hoist, both to be supplied by the James Cooper Mfg. Co., of Montreal. The shaft will be double compartment, and the hoist will have a capacity sufficient to handle two loaded skips, to be raised from a depth of ultimately 2,700 feet, at the rate of 1,000 feet per minute ; this will be the severest duty so far undertaken by any electrical mining hoist in the world.

The electrical machinery is to be supplied entirely by the Canadian General Electric Co. The compressor motor will consist of a 300 kilowatt three phase synchronous motor, operating at 200 revolutions per minute, and operating the compressor fly wheel directly by a rope drive without intermediate shafting.

The hoist will be operated by a 300 h. p. induction motor, capable of operating up to 600 h. p., operating in synchronism at 300 revolutions per minute, and handled by a regulator similar in style to the street railway controller. By use of a large external resistance any desired variation in speed may be obtained up to synchronism. The operation of an alternating hoisting motor of this capacity is a very nice engineering problem.

Power to operate this machinery will be obtained from the three phase circuit of the West Kootenay Power Company. In connection with the latter, it may be mentioned that the two large 1,000 h. p. revolving field generators supplied by the Canadian General Electric Company are now in position. The line, with step-up and step-down transformers, is completed, and the plant is expected to commence operation within the next two or three weeks.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By Wm. Thompson.

[Article 5].

Having determined the nature of impurities contained in the feed water, it next becomes an important consideration as to what will be the nature of scale formed when impurities are precipitated, or what effect the water will have on boiler parts provided no scale-forming material is present.

It is quite obvious that a water containing such impurities as those in sample No. 1 described in last month's issue cannot form scale except at very high degrees of concentration, or when water within the boiler has become completely saturated ; then, of course, crystallization will begin, but crystals will again dissolve when unsaturated molecules of water are brought into contact with the crystals. This form of scale will never be met with except in cases of extreme ignorance or carelessness, and need not be discussed at any length. As will be observed, however, the whole of the impurities in this water are non-volatile in the presence of heat at temperatures met with in ordinary boiler practice, and consequently as water evaporates into steam impurities are left behind, and a gradual increase in density takes place. The impurities, being soluble in water, remain in solution, and water in boiler becomes more and more saturated. Impurities being alkaline in reaction, a very high degree of alkalinity is in course of time reached. While the alkalies do not, as a rule, attack iron very readily, they attack brass alloys vigorously, reducing the metallic elements and causing a great deal of trouble, and in many cases serious damage has resulted.

Another very important reaction that sets in in waters of this kind is the formation of magnesium chloride, as mentioned in earlier articles, and as a consequence, free hydrochloric acid is liberated, which, being very corrosive even when diluted, no part of the system from boiler to exhaust on engine is quite free from danger of corrosion from this source.

The conditions under which a boiler feed water is to be used plays a very important part in the treatment required and the effect a water will have on the boiler parts. For instance, where good water is scarce, or in plants where economy has been carefully studied, it has become a common practice to use surface condensers, draining condensed water to a hot well and returning therefrom to boiler, using over and over again. In thoroughly equipped plants loss by evaporation is very small and quantity of fresh water used small, consequently the water may be returned to boilers many times daily. Waters that are low in dissolved solids in the first instance deposit very little scale-forming material. Condensed water from hot well being practically a distillate from original water, contains no scale-forming agents, and is, in the absence of oil, practically pure. This may, at first glance, be considered a very happy condition of things ; unfortunately, practice has shown it to be in many cases the reverse. Instead of scale forming, the boiler parts are very often found to have suffered from pitting and corrosion. Explanation of this condition appears difficult, and corrosion of boilers has often been charged to presence of organic acids, when, as a matter of fact, the purity of the water itself may be said to be responsible. When water is sent to hot well it is brought into contact with atmospheric air, and, being pure, readily absorbs or takes into solution some of the gaseous elements contained therein. Reference to my first article on this subject will readily explain the cause of pitting or corrosion due to the presence of free oxygen in the water.

We have already seen that the most troublesome scale-forming impurities held in chemical solution are the salts of lime and magnesia as usually met with in feed waters.

As conditions of use vary, so will nature of scale formed vary. Particularly is this the case with scale formed from the salts of magnesia. These salts in many cases are peculiarly unstable, and this fact is not sufficiently taken into account either by chemists or engineers. The carbonates of lime are, except in very exceptional cases, always accompanied by a certain proportion of the carbonates of magnesia. Personally, in my experience I have never found carbonate of magnesia entirely absent from a natural water when carbonate of lime was present. I have, as would naturally be expected, found carbonate of magnesia present when the entire lime was present as sulphate.

In examination of a boiler scale, it occasionally happens that the general appearance of a scale is such as would lead the engineer to suspect the presence of a strong bonding agent, such as sulphate of lime, while complete analysis shows the scale to be practically free from sulphates. While the carbonates of lime and magnesia form in presence of organic matter, and especially in high pressure boilers, hard compact scale in many cases, analysis of scale will show that the whole of the bases of these metals cannot be combined with carbonic anhydride. The reason for this is evidently the reducing of part of one of the compounds to an hydro-oxide. Since magnesia is the least stable of the two bases, it is the writer's opinion that the magnesium carbonate immediately in contact with the boiler plate is reduced from a carbonate to an hydrate, and carbonic acid gas liberated. When this occurs in presence of sulphate of lime a particularly obnoxious scale is formed.

A sample of scale sent to my laboratory of a very troublesome nature, being very hard and tenacious, and having very high power as a non-conductor of heat. While it was, according to sample, less than ¼ inch thick, still its construction made it extremely dangerous. Subsequent analysis proved it to have the following composition :

Silica	9.66%
Alumina and peroxide of iron	3.44%
Sulphate of lime	57.37%
Carbonate of magnesia	27.12%
Magnesium hydro-oxide	2.07%
	99.66%

In this case a portion of the magnesium carbonate through the action of heat had been reduced according to following equation :

$$Mg\,CO + heat = Mg\,O + Co_2,$$

the oxide of magnesia thus formed then combining with water to form the hydro-oxide, which is only partially soluble in water.

$$Mg\,O + H_2\,O = Mg\,(OH)_2.$$

The hydro-oxide is extremely fine, and under conditions existing within the boiler forms a ready bonding material, and especially so in presence of sulphate of lime.

The carbonates of lime and magnesia when precipitated at such at low temperature, form porous, easily-removed scale, having very low specific heat, consequently cannot be classed as equally dangerous with those scales of more compact construction. Some idea of nature of scale formed can be arrived at from a study of the physical and chemical properties of the following samples of scale analyzed in my laboratory.

The first is a sample of scale formed from water containing salts of both lime and magnesia, and both hard and tenacious, containing the following parts in 100 :

No. 1. Supplied from Montreal, Que :

Silica	1.56
Alumina and peroxide of iron	4.30
Carbonate of lime	26.95
Sulphate of lime	52.65
Carbonate of magnesia	14.20

No. 2. Sample of scale from New Toronto, Ont.—Shows a rather uncommon condition of scale forming. As seen by composition of scale, a large quantity of mud (greatest portion of which must have been held in mechanical suspension) was present ; this, combined with sulphate of lime, formed a particularly troublesome scale. The composition of impurities in the water from which this scale was formed is illustrated in sample No. 6, last month's issue, and is worthy of remark for two important reasons : First, analysis of water shows very little alumina present, consequently very little mud was held in suspension, while scale shows a large quantity of alumina. This difference is accounted for by the fact that weather conditions had much to do with the presence of mud, and sample sent for analysis showed water under best possible conditions ; secondly, it will be observed that water contains both carbonates of lime and magnesia, while carbonate of lime is entirely absent from scale. This circumstance at first somewhat puzzled the writer, until he ascertained that the engineer in charge was using refined coal oil to remove scale. As is very often the case, oil contains excess of free sulphuric acid acquired during process of refining in sufficient quantity to reduce the whole of the carbonate of lime to sulphate and also a portion of the carbonate of magnesia to sulphate of magnesia, which latter, being soluble in water, does not appear in the scale.

This sample of scale contains the following parts in 100 :

Silica	3.98
Alumina, with traces of peroxide of iron	33.80
Sulphate of lime	53.52
Carbonate of magnesia	8.78

No. 3. Sample of scale from Walkerton, Ont.—Light, porous and easily broken or removed, a typical type of carbonate scale formed at low temperatures. Composition :

Acid insoluble	.38
Alumina and peroxide of iron	1.10
Carbonate of lime	92.08
Carbonate of magnesia	5.60

Carbonate in presence of organic matter form in many instances very hard scales, degrees of hardness varying with nature of organic matter present.

No. 4.—Sample No. 4, received from London, Ont., is an excellent type of scale of this kind, being very hard and tenacious. The organic matter present in this case was largely composed of oil, which by action of heat has become carbonized, and although scale was not more than ¼ inch thick, it was of a very dangerous type. Composition :

Acid insoluble	.70
Aluminum and peroxide of iron	.75
Sulphate of lime	2.33
Carbonate of lime	80.07
Carbonate of magnesia	9.91
Organic matter	6.04
	99.80

Another sample of scale with nearly the same composition, thicker, but much coarser in granular construction, due to difference in nature of organic matter, yielded on analysis :

Acid insoluble	.30
Alumina and peroxide of iron	.70
Sulphate of lime	3.32
Carbonate of lime	83.75
Carbonate of magnesia	6.20
Organic matter	6.01
	100.28

The loss occasioned by allowing such formations as above to remain on the sheets and tubes of a boiler is so important a factor in economy that it is almost impossible to estimate it. It has been stated on good authority that the formation of an incrustation $\frac{1}{16}$ of an inch in thickness will increase the fuel consumption 12% over a boiler working under similar conditions with clean shell and tubes. This statement is, however, obviously in error, since scale of different composition has different heat conducting powers, and loss must vary in accordance with composition of scale, as well as with variation in thickness. The fact remains that the incrustation formed within a boiler has a very much lower conductivity than has the plate of the boiler itself, even under most favorable conditions, so that loss is bound to occur if incrustation is allowed to accumulate ; and loss is not only loss of heat and consequently loss of fuel, but serious damage to boiler may occur. Such is the non-conducting power of many even very thin scales that plates are liable to become over-heated, while scale has a high non-conductivity, when interposed between boiler shell and water it has very low tensile strength ; consequently, when plates become overheated, internal pressure forces the affected part outward, and boiler is badly damaged, even if serious explosion does not occur.

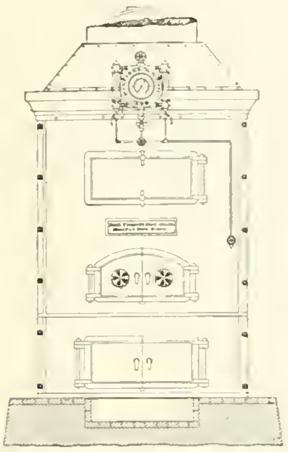
(To be Continued.)

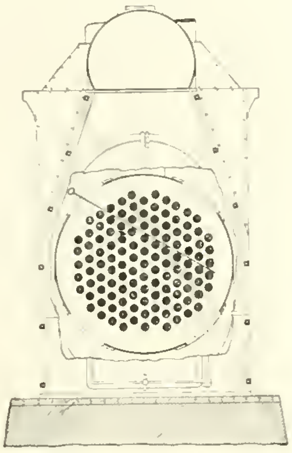
The question of a franchise for electric lighting in Ottawa is still unsettled. It appeared that the offer of the Ottawa Electric Company would be accepted, but it is now proposed to refer the matter back with a view to ascertaining on what terms and conditions the plant and property of the Ottawa Electric Light Company can be acquired by the corporation.

MUMFORD'S IMPROVED BOILER.

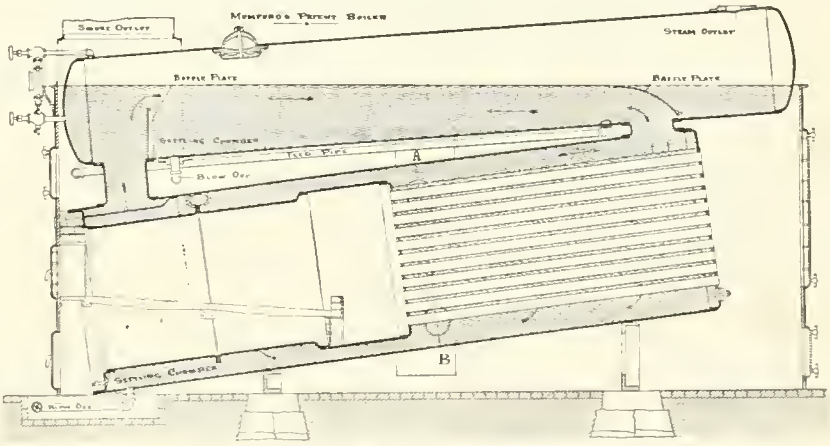
On this page we illustrate a new boiler intended to meet the demand for greater economy and efficiency than are obtained from the ordinary brick set boiler. The water circulation is similar to that of a water tube boiler, and for very high pressure it is built with a corrugated furnace. It was designed by Mr. J. A. Mumford, and is manufactured in Canada by the Robb Engineering Co., of Amherst, N. S., and in the United States by a large concern in Erie, Pa.

The furnace has ample room for mixing the gases and is surrounded by water, so that the direct and radiant heat of the fire is readily absorbed. The heated gases pass directly through well proportioned tubes and return around the shell of the boiler and underneath the drum, making every square foot of the boiler effective as heating surface, and enter the smoke stack with sufficient temperature remaining to produce good natural draft. By covering the case and drum with a non-conducting material the loss of heat usually found in the setting of boilers may be reduced to a minimum.


Front View of Mumford's Improved Boiler.


End Elevation of Mumford's Improved Boiler.

The water circulates continuously from the front to the back of the boiler, up the back connection to the drum, where the steam freely separates from the water, and down the front connection to a point below the fire. This positive circulation admits of using forced draft, increasing the horse power of the boiler without foaming or priming, the increased temperature increasing the speed of the water circulation without any evil effects.



Sectional View of Mumford's Improved Boiler.

Special arrangements are made to avoid trouble with bad water. The feed pipe enters the drum near the back end, and part of the sediment is deposited in a settling chamber at the front end of drum and may be blown out. Additional impurities that are carried down the front connection are deposited in another settling chamber below the furnace. This leaves very little, if any, impurity to form scale on the furnace and tubes, and it may be removed by a scraper inserted through hand holes in the shell, the tubes being spaced so that all can be cleaned. Doors are placed in the casing opposite these hand holes, which also give facilities for cleaning the outside of the shell.

The Robb Engineering Company inform us that they have already installed two of these boilers in Montreal and others in Lethbridge, Fort William, Ont., Parrsboro, N. S., while a number more are ordered.

FIFTY THOUSAND VOLT TRANSMISSION.

It is a fact not generally known, says the Electrical Engineer, that a transmission of 50,000 volts was some time ago tried for a period of two weeks from the water power plant at Telluride, Col., to the Gold King stamping mills there. The Telluride transmission is well known as one of the earliest in this country. The first plant consisted of a single-phase 3,000-volt alternator with direct transmission to a synchronous motor three miles away. This has since been replaced by a three-phase transmission, with step-up and step-down transformers. It was about the time that the change was made that the experiment was tried of transmitting at 50,000 volts three-phase alternating current. The transformers used were those now employed on the three-phase transmission there, said transformers being arranged to give a number of different voltages from 50,000 down according to the way they were connected.

As said before, this transmission at 50,000 volts three-phase current was kept in service for about two weeks, and no accidents occurred during the time. The line consisted of galvanized iron telegraph wires supported on glass insulators. It was found that the self-induction afforded by the iron wire had a beneficial effect in counteracting the capacity of the line. The experiment was not continued for a longer time because a rainy season came on and proper provisions against lightning were not at hand. The transmission line is three miles long, and runs up a steep mountain-side and over a very wild country.

PURE WATER AND NEW BOILERS.

The corrosive powers of pure water on new or unscaled boilers was illustrated in the city of Glasgow when a new water supply was introduced from Loch Katrine, one of the purest waters in the world which are available for city consumption. The former supply had been poor and calcareous, and old boilers were much coated with lime scale. To the dismay of the users those who had put in new boilers or new tubes found them rapidly corroding, while the old scaled and coated boilers remained as before. Those, too, who had removed every possible trace of old incrustation from their old boilers by mechanical means, intending thus to get, as they expected, the full benefit of pure water, were also badly troubled by corrosion, and even the old boilers, as the scale was gradually removed by the unvarying soft and pure water from the lake, were more or less corroded when no means were taken to prevent it.

THE NORTHEY GAS ENGINE.

Of late years the gas engine has attracted considerable attention as a motive power, and although we do not predict that the day of steam engines is passing away, the fact cannot be disputed that for certain work the gas engine has some points in its favor. As to the efficiency of the gas engine in comparison with steam, we are not prepared to talk up the cudgels in favor of the former, but it can safely be said that it occupies small space, removes the necessity of handling bulky fuel, produces no ashes, dirt or refuse, and requires but a very little water supply.

The Northey Manufacturing Company, of Toronto, have for some time been manufacturing a gas and gasoline engine, for which they report a growing demand, chiefly for engines of from 4 to 6 horse power. The accompanying illustration shows a gasoline engine belted to a dynamo. The details of construction of the engine, as given by the manufacturers, are as follows: It consists, broadly speaking, of a base, cylinder, piston, connecting rod, crank shaft, fly wheels and valve gear. The base and cylinder are substantial castings of proper weight to insure durability and freedom from vibration, and are made of high-grade cast iron. The piston is very long to give large wearing surface, and is made of special iron, fitted with spring rings. The connecting rod is fitted with a phosphor bronze bearing at upper or wrist pin end, so arranged as to take up wear easily. The other end is fitted with babbitted boxes of the marine type. The crank shaft is of steel, finished to gauge. The valves are of the poppett type, and lift squarely off their seats without friction. The valve gear is enclosed in an iron housing absolutely dust and grit proof, and runs constantly in oil, thus insuring perfect lubrication and great durability.

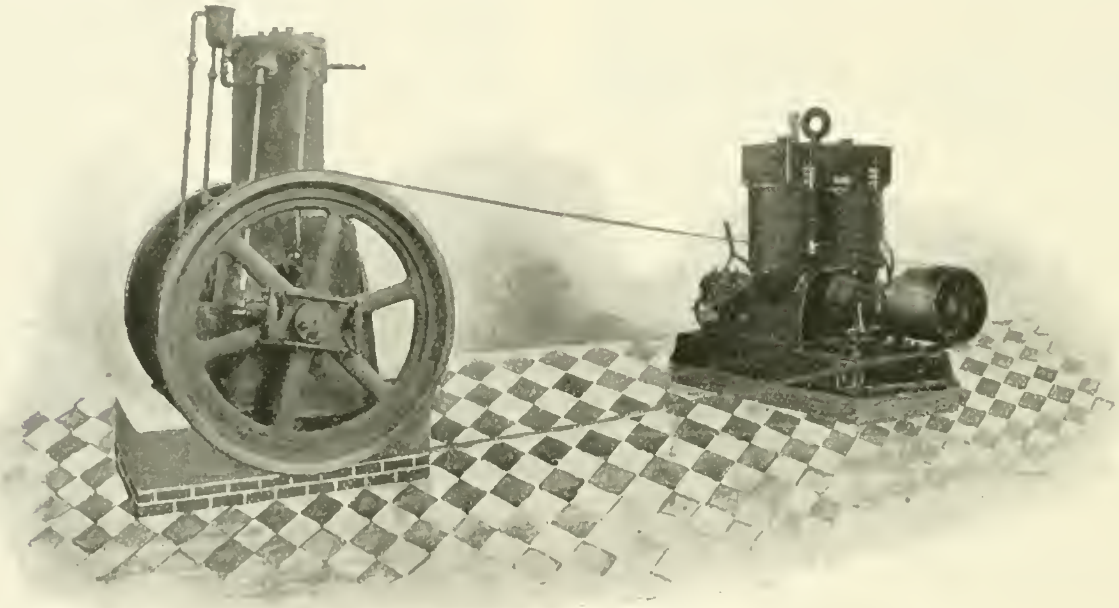
The engine is fitted with two fly-wheels, which is claimed to be the only method which puts equal wear on both bearings. If only one fly-wheel is used the bearings must wear unevenly, as the box on the fly-wheel side wears downward, and the box on the opposite side upward.

The irregular speed, such as is met with in most governors, is overcome by a graduated charge governor, which controls the amount of the charge admitted to the cylinder in proportion to the work being done, and allows the engine to use only what is actually needed. If engine is running light the charge is cut off to what is necessary only to keep engine up to speed, and if engine reaches a few revolutions over the regular speed, the charge is cut off altogether, and thus there is no possibility of engine running away.

The arrangements for keeping the engine from becoming overheated are very complete; a heavy galvanized iron tank is supplied with each engine, to hold water sufficient to keep engine at proper temperature. The water is circulated through this tank by the heat of the engine cylinder, the warmer water going to top of tank, and the cooler portion coming from bottom.

All engines are fitted with electric or incandescent tube igniter. The electric igniter has a positive motion, giving a wiping contact above and below a small wire electrode, which can be replaced from outside of engine in the simplest manner. A battery of eight cells furnishes the small amount of current needed, and is maintained at a very low cost.

The gasoline supply is stored in a heavy galvanized iron tank, which is placed outside the building, and connection made direct from tank to engine by ¼ or ⅜ inch pipe. A small and very simple pump on base of engine draws the gasoline from tank and delivers it to engine cylinder, so that at no time is the gasoline exposed to the action of the outer air.



Northey Gas Engine Driving Dynamo.

The gas engine is claimed to be specially adapted for electric lighting, the graduated charge governor ensuring the even, steady speed indispensable for such work. Small plants installed in opera houses, buildings, mines, etc., are said to show a great economy over the use of gas for illuminating purposes, as if the gas is used in the engine for motive power, it will produce twice the light in incandescent lamps, and if arc lights are used the difference is still greater in favor of the gas engine.

As to the cost of operation, it is guaranteed that the consumption of gas will not exceed from 18 to 22 feet, or one-tenth of a gallon of 74 degrees gasoline, for each horse power produced per hour. With gas at 90 cents per 1,000 feet, the cost would be about 18 cents per horse power for ten hours work.

The Northey Manufacturing Company will gladly furnish any further particulars desired by interested persons.

RECENT CANADIAN PATENTS.

A PATENT has been granted to Mr. John Sharp, of Gravenhurst, Ont., for a water wheel, as shown by the accompanying cut. The claim is for a wheel secured to a vertically journalled shaft, and a series of radial buckets inclined from the vertical at substantially an angle of forty-five degrees, and secured to the rim, in combination with a frame surrounding the buckets, a cover therefor provided with a series of openings, each extending over two or more buckets, and a curved conductor connected with each of the said openings and with a source of water supply, the arms in the conductors being such as to discharge the water at substantially a right angle to the surfaces of the buckets; a curved conductor connected with each of above said openings, a tank with which the said conductors are connected, a flume connected with the tank, a cut-off valve in the said flume, and a cut-off valve for each conductor, substantially as set forth.

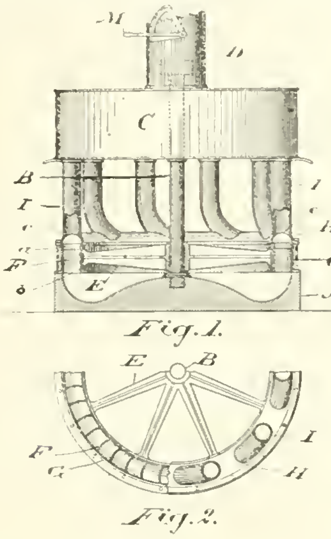
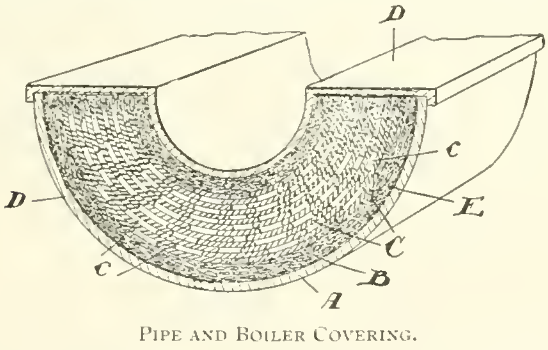


Fig. 1.

Fig. 2.

TURBINE WATER WHEEL.

Mr. Henry C. Mitchell, Toronto, has obtained a Canadian patent, No. 58,788, for a pipe and boiler covering, as herewith illustrated. It is claimed to be a non-conducting covering, comprising centrically arranged flakes or laminæ of mica, forming multitudinous hollow non-communicating interspaces and a suitable binding medium permeating the outer portion of the layers and forming at the inner an irregularly formed surface, whereby the covering is held in shape and position, etc. A method of forming a non-conducting covering for boilers and the like, consisting in spreading upon suitable backings for the outer and inner portions of the covering, a composition comprising a damp or wet binding medium, intermixed with mica particles, superimposing upon the outer portion the concentric flakes or laminæ of mica, placing the inner and outer portions together to enclose the central laminæ, and finally subjecting the whole to a suitable drying process whereby the binding medium is hardened and permeates into the mass, as and for the purpose specified.



PIPE AND BOILER COVERING.

NEW CABLE ACROSS THE GULF OF GEORGIA.

THE C. P. R. recently completed the laying of a new cable across the Straits of Georgia, from Vancouver, B. C., to Departure Bay, on Vancouver Island. The distance, as the crow flies, is about 32 miles, but it was found that the bed of the gulf was broken up by innumerable hills, mountains and gulleys, nearly 8 miles of wire being used in covering this irregular space, making the cable 40 miles in length.

The cable was made by the Telegraph Construction and Maintenance Company, of London, Eng. It weighs about 320 tons, and its total length when it left the manufacturers was 45 miles. Some idea of the difficulty experienced in handling it may be had from the fact that it took the crew of the Tartar two days and a half to get it on board at Southampton. The duty on the cable was $10,000, and by the time the company received it in Vancouver it cost them considerably over $50,000. In diameter the cable is slightly more than an inch and a half, and it contains three wires or cores, which provide three distinct services or connections. Each of these cores is about the size of a lead pencil, and each contains fine copper wires packed in jute and insulating material. Inside of this they are armored with 14 galvanized steel wires, wound spirally. Inside of this again is the final covering of tarred jute canvas.

The old cable which it replaced was a single core, or single wire, and was laid in March, 1881. Since that time it has been broken several times, and has given much trouble.

From shore to shore the cable was laid almost without a hitch, the steamship Tartar being employed. The receptacle for the cable was a steel tank about 35 feet in diameter and 12 feet high. In the centre was a circular spool-like frame, around which the cable was coiled. The work was carried out under the supervision of Mr. F. B. Gerrard, assistant superintendent of the Commercial Cable Co., of Canso, N.S., and Mr. J. W. Wilson, superintendent of C.P.R. telegraphs in Vancouver.

PERSONAL.

The death is announced on the 22nd ultimo, at his residence in Toronto, of Mr. Benjamin W. Stokes, late engineer and electrician at Centre Island, in his 43rd year.

Mr. J. A. Kammerer, of the Royal Electric Company, has returned from Atlantic City, so far improved in health as to be able to put in part time at his office. He is steadily gaining strength, and, assisted by the returning warm weather, will no doubt soon be entirely himself again.

Mr. P. A. Dickson died at Brantford, Ont., on April 25th, at the age of 40 years. Deceased was for a number of years electrician for the Brantford Electric Power Company, leaving there last summer for British Columbia, where he contracted a severe cold, which resulted in his death.

Much regret is felt at the removal to England of Prof. Carus-Wilson, of the Engineering Department of McGill University. Prof. Wilson sailed with his family from New York on the Campania on April 23rd, and on arrival in England will reside at Hanover Lodge, Kensington Park, London, W.

Professor H. L. Callendar, of the Physics Faculty of McGill University, has received the appointment to the chair of Physics at University College, London, England. Prof. Callendar's work at McGill has been greatly appreciated, and general regret is expressed at his forthcoming departure. The results of some interesting experiments on the condensation of steam conducted by him appeared in our April issue.

Mr. W. J. Green, who for many years has occupied the position of local agent for the Canadian Express Co., Bell Telephone Co., and Grand Trunk Railway Co., at Walkerton, Ont., has recently removed to Berlin, where he will fill the position of local manager for the Bell Telephone Co. Before leaving Walkerton Mr. Green was presented by the Mayor, on behalf of the citizens, with a handsome gold watch, and Mrs. Green with a beautiful chair, accompanied by an address expressive of the good wishes of the community. Mr. Green was also presented on behalf of the Masonic fraternity with a past master's jewel. The people of Berlin will require from Mr. Green no better recommendation than the spontaneous expressions of esteem bestowed upon him by those who best know his worth.

Mr. L. A. Campbell has been appointed manager of the West Kootenay Power & Light Company, and has left for British Columbia to take up his new duties. Mr. Campbell has had an extensive experience in electrical work, having been connected with the Fort Wayne and Edison General Electric Companies in the early days of the industry in Canada. Since the formation of the Canadian General Electric Company he has been employed on the construction and engineering staff of that company, and, on the departure of Mr. W. Rutherford, chief engineer of the company, for England, eighteen months ago, succeeded him in that position. The installation of the West Kootenay Power Company's plant has been carried on under Mr. Campbell's personal supervision; he is therefore thoroughly acquainted with the conditions under which it can be most favorably operated, and his selection to fill the position of manager is a very fortunate one for the company. His many friends in the electrical business in the east will join in wishing him the best possible success in his new field of labor.

TRADE NOTES.

James Pender & Co., St. John, N.B., have put in a new 15 h.p. Goldie & McCulloch engine.

A. Bobson, Esq., Beaverton, has purchased a 400 light incandescent dynamo from the Canadian General Electric Company.

Mr. T. E. McLellan, manager of the Berlin and Waterloo Street Railway, has resigned his position to go to the Klondyke, and will be succeeded by Mr. H. Hilborn, of Montreal.

The British Columbia Iron Works Co. have ordered a 6 kilowatt incandescent dynamo from the Canadian General Electric Co. for a steamer which they are building for the Klondyke trade.

The Jones & Moore Electric Company, of Toronto, have just installed a lighting plant on the steamer "Northern Belle," comprising 80 16 c.p. lights, and fitted with marble switchboard and first class instruments. The work was done at Collingwood, the installing expert being Mr. J. H. Ward.

The Hudson Bay Company have placed a contract with the Canadian General Electric Co. for two 100 light incandescent equipments, to go on their new steamers, running from Vancouver and Victoria to the Stickeen river.

The Eugene F. Phillips Electrical Works, Montreal, have been given the contract to supply all the trolley, bond and feed wire required in the construction of 25 miles of electric railway at Jamaica, West Indies. This is the new road with which Mr. Holgate, formerly manager of the Montreal Park and Island Railway, is connected.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make his series of tests complete in every particular.

WM. THOMPSON.

THREE-WIRE SYSTEM.

IN the three-wire system the lamps are really arranged in sets of two in series. The two outer wires have double the potential of the lamps, and since, owing to the lamps being in series, one-half the current only is required as compared with multiple arc two-wire system; therefore, to carry one-half the current with twice the difference in potential or double the E.M.F., a conductor with one-quarter the area of cross-section suffices.

Dynamos are frequently set in series in large buildings, and their terminals wired out on the three-wire system to save copper. Since each of the wires is but one-quarter the size of the wires in the ordinary two-wire system, it remains clear that the weight of copper required on the three-wire system is but $\frac{3}{8}$ of that required on ordinary two-wire systems. The formulæ already laid down for two-wire work apply to three-wire calculations as regards size of mains, if denominator of formula be multiplied by 4.

$$\text{C M or } d^2 = \frac{21.58 \times \text{L N} \times (100 - \%)}{\text{R} \times \% \times 4}$$

This formula gives required cross-section of mains in circular mils, using commercial copper wire as a conductor.

ALTERNATING CURRENT SYSTEM.

In alternating systems we have two sets of mains to deal with, primary and secondary, both of which have different E. M. F.'s.

Theoretically, the rules deduced from Ohm's law are not correct as applying to this system of generation, because calculations must be made to allow for conversion from primary to secondary current. The ratio that the primary E.M.F. bears to the secondary E.M.F. is expressed by dividing the primary E.M.F. by the secondary E.M.F., and is termed ratio of conversion. Thus,

$$\frac{\text{E primary}}{\text{E secondary}} = \text{Ratio of Conversion.}$$

The current in the primary is equal to the current in the secondary divided by the ratio of conversion.

Example: On an alternating circuit whose primary E.M.F. is 1,000 volts and secondary E.M.F. 50 volts, there are 500 lamps, each having a resistance of 50 ohms, what is the primary current and what the secondary?

$\frac{1000}{50} = 20$, ratio of conversion.
$\frac{50}{500} = .1$, combined R of lamps.
$\frac{50}{.1} = 500$ amperes current on secondary.
$\frac{500}{20} = 25$ amperes current on primary.

Current being determined, rules deduced from Ohm's law apply exactly as shown for direct current calculations.

Example: An alternating generator has 4,000 feet of primary main attached with an E.M.F. across the terminals of the machine of 1040 volts; it is decided to allow a drop of 40 volts on the primary at the convertor. The secondary main has attached to it 750 16 c.p. lamps at an E.M.F. of 50 volts, each lamp having a resistance of 50 ohms. What is the resistance on the primary wire?

$1040 - 40 = \frac{1000}{50} = 20$, ratio conversion.
$\frac{50}{50} = 1$ amp., current each lamp.
$750 \times 1 = 750$ amps., total current on secondary.
$750 \div 20 = 37.5$ amps. current on primary.
$\frac{1}{37\frac{1}{2}} \times 40 = 1.06$ ohms resistance on primary.

To obtain the required size of primary mains in circular mils, calculate by formula for two-wire direct current, and divide the result by the square of the ratio of conversion. Or

$$\text{C M} = \frac{21.58 \times \text{L N} \times (100 - \%)}{\text{R} \times \% \times \text{R C}^2}$$

Example: An alternating current generator has an E.M.F. across the leads of 1040 volts, and current is delivered 4,000 feet from station, E.M.F. at terminals being 1,000 volts; current consists of 1,000 lamps, having a resistance of 50 ohms each on a 50 volt secondary circuit. What should be the cross-section of the primary mains in circular mils, and what is resistance of same main to allow a drop of 40 volts as shown?

$$\left.\begin{array}{l}1000 = \text{E.M.F. at terminals of primary} \\ 50 = \text{E.M.F. on secondary}\end{array}\right\} = 20 \text{ R.C.}$$

$40 \div 1040 = 3.84\%$ drop in potential.

$$\frac{21.58 \times 4000 \times 1000 \times (100 - 3.84)}{50 \times 3.84 \times 20^2} = 108{,}079 \text{ C. M., required cross-section of primary main in circular mils.}$$

Total current on secondary $= 1000 \times \frac{50}{50} = 1000$ amps.
$1000 \div 20 = 50$ amps. secondary current.
$\frac{1}{50} \times 40 = .8$ ohms resistance, primary main.

HORSE POWER CALCULATIONS.

The power or force required to do a certain mechanical work is usually referred to as foot pounds. That is, one pound raised one foot high is called a foot pound, without reference to the time required to do the work. Therefore, if we want to find force or energy required to be expended to do a certain work expressed in foot pounds, we require to multiply the weight required to be raised by the distance in feet through which weight has to be lifted.

A horse power is fixed as the work performed in raising 33,000 pounds one foot high in one minute, or what is exactly the same thing, raising one pound 33,000 feet high in the same period of time. Here we have time required to do a certain work, and note of this must be taken in our calculations.

Then to reduce force exerted at the piston of a steam engine, and to express this force in horse power, we require to know effective pressure against the piston throughout the stroke, and distance travelled in feet by the piston per minute. And to do this use the following established rules:

1st. Find area of piston in square inches.

2nd. Find the total pressure in pounds on the piston by multiplying the area by the mean effective pressure per square inch.

3rd. Find the distance in feet traversed by the piston per minute by multiplying the length of stroke in feet by twice the revolutions per minute.

4th. Find the energy exerted by the engine expressed in foot pounds per minute by multiplying the total pressure in pounds against the piston by the travel in feet per minute.

5th. Find the horse power by dividing total foot pounds per minute by 33,000.

From this, then, we can construct the following simple formula:

$$\frac{\text{A.N.P.S.}^1}{33{,}000} = \text{H.P.}$$

Where A = Area of piston in square inches.
N = Number of strokes per minute (revolutions multiplied by two.)
P = Mean effective pressure per square inch.
S^1 = Length of stroke in feet.

Example: Find the horse power of an engine 9.5 inches by 12, running 280 revolutions per minute, mean effective pressure throughout the stroke being 35 pounds per square inch.

$9.5^2 \times .7854 = 70.88$ square inches area.

70.88 × 35 =
70.88
35
35440
21264
2480.80 total pressure against piston.

280 revolutions per minute.
2 strokes per revolution.
560 strokes per minute.
1 length of stroke in feet.
560 feet travelled by piston per minute.

2480.8 pressure on piston.
560
1488480
124040
1389248.0 foot pounds per minute.

33000)1389248.(42.09 horse power.
132000
69248
66000
324800

We have in this formula two constants, .7854 constant multiplier to find area, and 33000 constant divisor to find horse power, consequently by dividing .7854 by 33,000 we get a constant multiplier as a result, and thus shorten our method.

.7854 ÷ 33000. = .0000238, which becomes a constant multiplier, and our formula then becomes $(d^2\ N\ P\ S^1) \times .0000238 =$ H. P.

Example: Using this formula find horse power of an engine, dimensions, etc., as per last example.

9.5 = diameter of piston.
9.5
$90.25 = d^2$
560 = strokes per minute.
5415 00
45125
50540.00
35 = mean effective pressure.
252700
151620
1768900
.0000238 = constant multiplier.
14151200
5306700
3537800
42.0998200 = H. P.

CALCULATING HORSE POWER FROM INDICATOR DIAGRAMS.

An indicator diagram is practically a record of the action of the steam on the piston throughout the stroke of an engine, and if we are enabled to ascertain the area of the diagram, having the length of the diagram and scale of spring used before us, it becomes an easy task to find the mean effective pressure of the steam throughout the stroke.

The area of the diagram is easiest found by use of a small instrument called a planimeter, which should be set to a natural scale, that is, area of diagram should read in square inches. Knowing the area and dividing by length of diagram in inches, will give us height of a regular body of an equal area.

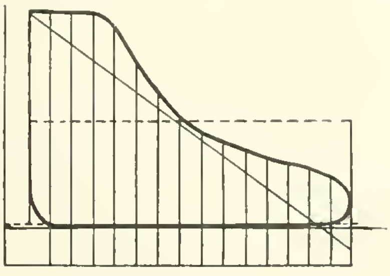


FIG. 7.

Fig 7 represents a diagram 3 inches in length, and the irregular body has an area of three square inches. If we reduce this area to a regular body with at least two of its sides equal, we get a diagram, as shown by dotted lines, exactly one inch in height; multiplying this by scale of spring used, we get M.E.P. throughout the stroke. Therefore, we can construct a formula as follows to calculate M.E.P. from an indicator diagram:

Area ÷ Length × Scale of spring = M.E.P.

The horse power calculation can be very much shortened by using what is known as an engine constant; that is, the power developed by an engine with M.E.P. of 1 pound per sq. inch, and is particularly useful where horse power calculations are being constantly made from same engine.

Abreviated the formula would then read:

Engine constant × M.E.P. = H.P

Example: Using engine constant and M.E.P. find I.H.P. of a single cylinder engine $9\frac{1}{2}'' \times 12''$ running 280 revolutions per minute. Diagram measures 3 inches in length, and planimeter shows area to be 2.625 sq. inches, scale of spring used in indicator being 40 pounds per inch of compression.

First, find power developed by engine with a mean effective pressure of one pound per square inch:

$9.5^2 = 90.25$
$90.25 \times 560 = 50540$
$50540 \times .0000238 = 1.2$ H.P.

Then power developed by this engine with steam pressure on piston equalling one pound per square inch of area is 1.2 H.P., which is our engine constant. Next find mean effective pressure shown by diagram:

Area ÷ Length = 2.625 ÷ 3 = .875 average height in inches.
.875 × 40 scale of spring used = 35. M.E.P.
Then 1.2 × 35 = 42. horse power.

In the absence of a planimeter, it becomes necessary to devise a method of arriving at area of diagram. To those engineers who are unacquainted with geometry this is sometimes difficult to do.

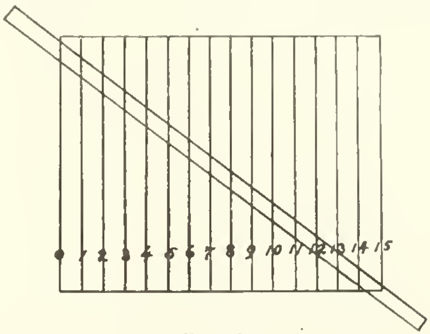


FIG. 8.

With every indicator is sent out a number of rules graduated in such a manner that the divisions between each inch correspond exactly with scale of spring used; by the aid of these it becomes comparatively easy to subdivide into equal divisions. For instance, suppose we wish to divide Fig. 7 into 15 equal parts by using a graduated scale laid across diagram at an angle so that the divisions 1 and 15 shall exactly coincide with lines at each end of diagram, and marking off at each division on scale intervening by erecting at each of these points an ordinate at right angles with atmospheric line, we get 15 exact divisions. It now remains for us to ascertain the pressure represented in the centre of each of these divisions, and finding the mean pressure by adding the pressures together and by dividing the total by number of ordinates erected, we get total mean effective pressure calculation of H.P. It then becomes a simple repetition of examples already described. To convey meaning clearly Fig. 7 is reproduced in Fig. 8.

[THE END.]

SUPERIOR BOILER COMPOUNDS.

THE advertising pages of this issue contain the announcement of the Canadian Chemical Compound Company, and as this company is probably unknown to some of our readers, being of recent organization, a few words of introduction may here be given. The personnel comprises Messrs. A. M. Wickens, E. J. Philip and D. J. LeRoy. The headquarters of the company are in the Temple Building, Toronto, where nicely fitted and convenient offices have been secured; while the Montreal office is located in the Street Railway Chambers. The factory is at 66 River St., Toronto.

As implied by the name, the company are manufacturers of chemical compounds for boilers, and being composed of thoroughly practical men, it is not to be wondered at that they are producing an article second to none in the market. The manufacture of the compound is under the supervision of Messrs. Wickens and Philip, who have given the matter very careful study for some time past, while Mr. LeRoy has charge of the sales department. From a neat booklet just issued, we learn that the company have made a somewhat new departure, in that they are manufacturing three distinct brands to meet the necessities of different waters, this step being determined upon after making a large number of analysis of various waters used in Canada.

Their "Canadian" brand is suitable for the water in our Great Lakes, and all waters of a like quality. It is claimed to prevent internal pitting and corrosion of the boiler and all apparatus it passes through. Their "Automatic" brand is specially prepared for waters carrying heavier and harder sulphates, such as some of the river waters and some spring well waters. This brand is more active than the "Canadian," and is exceptionally good for water tube and other rapid steaming boilers used under hard and continuous firing. Their "Zinkolene" is said to be the outcome of a large number of carefully conducted tests with the most difficult waters in Canada, and will, it is said, succeed where all others fail. It is sharp and active and must be used according to special directions sent with each package, which are not sent to allay its sharpness, but to assist it in the loosening of very hard and difficult scale.

The compounds made by this company are liquid and purely vegetable, containing no acids or other injurious material, and are readily fed into the boilers. They are the results of years of experience by a practical engineer, assisted by a first-class chemist.

To show the importance of steam users looking to the prevention of boiler scale, it is estimated by eminent engineers and fully borne out by actual experience that $\frac{1}{16}$ inch of scale causes a loss of 13 % of fuel, $\frac{1}{4}$ inch 38 % and $\frac{1}{2}$ inch 60 %. The best of waters for steam boilers contains about 8 grains of scale-making properties per gallon.

ELECTRIC RAILWAY DEPARTMENT.

THE HAMILTON STREET RAILWAY.

The Hamilton Street Railway Company recently made application to the City Council for an amendment of the present agreement with the city under which the company has to pay over $13,000 a year for percentage and mileage. A meeting of the Finance Committee was held on April 4th to consider the matter. The company's solicitor presented figures which showed that there had been a falling off in receipts last year, and that no dividends had been paid since 1895. He attributed the falling off in receipts to the building of the radial railways, which cut into the local business, and stated that at the present time the company could not operate under the conditions. He proposed that the by-law should be amended to provide for the removal of snow from the track ; the company to sell nine instead of eight limited tickets for 25 cents, and to extend the time from 6.30 a.m. to 8 a.m., 11.50 a.m. to 1.30 p.m., and 5 to 6.30 p.m.; to carry children between 5 and 12 years of age for 3 cents, or sell ten children's tickets for 25 cents; also to allow its tracks to be used by radial railways entering the city on terms to be agreed upon. In lieu of these conditions the company asked that the franchise be extended to 1928, the mileage abolished, and the percentage be rearranged as follows: Receipts up to $200,000, 5 per cent.; receipts over $200,000, 8 per cent. Mr. Martin also submitted an alternative proposition to abolish mileages and percentages, and after paying expenses, etc., to equally divide the surplus between the city and the company until each receive $10,000 a year, then the city to receive the percentages under the by-law, the franchise to be extended to 1928, and radial railways to be allowed to use the company's tracks on the terms to be agreed to.

The Finance Committee submitted several questions to the company, which were answered in the following words: "The actual cost of the Hamilton Street Railway is represented by the capital paid up in cash, $204,704.40, and the bonds issued in 1894, $500,000 ; total, $704,704.40. The company's charter does not permit it to sell the railway, nor can the company control the shares of the shareholders, or bind the bondholders to agree to a sale, neither has the city power to purchase the railway. Very special legislation would, therefore, be required to enable such a purchase to be made, and it would take almost two years to obtain such legislation and pass the necessary by-laws. If the city decides to purchase the railway, and will now make a definite offer which the company can recommend to its shareholders, with a view to obtaining their assent to applying for the necessary legislation, the company will take that step, provided the interests of the company are properly safeguarded in the meantime by the franchise being extended till 1928 substantially upon the terms of the draft by-law now submitted (or the alternative offer), it being further provided that the city shall have the option to purchase out the company at the agreed price within, say, two years, should the requisite legislation and authority have been obtained in the meantime."

Some of the members of the Council are in favor of the city acquiring the railway, but there is a great difference of opinion as to the wisdom of municipal ownership, and the matter has been laid over for further consideration.

The Canadian General Electric Co. have closed a contract with the owners of the War Eagle mine, Rossland, B. C., for the electrical apparatus for operating a compressor plant and elevator.

A survey is being made for a short line of railway from Flower Station, Ont., to the mines of the Hamilton Smelting Company, Andrew Bell, C.E., of Almonte, having charge of the work. It may be an electric road.

The Halifax Tramway Company have recently finished the installation of a second 5000 light monocyclic alternator, which they are installing for their electric lighting service. This makes a total of 16,000 lights capacity in monocyclic apparatus installed by the Canadian General Electric Company in Halifax.

SPARKS.

The Vankleek Hill Electric Company, Limited, has been incorporated, with a capital of $15,000.

The Metropolitan Railway have placed an order with the Canadian General Electric Company for three additional G.E. 1,000 equipments.

The Canadian General Electric Company are installing a 110 kilowatt direct current railway generator for the Longue Pointe Asylum, Quebec.

Francis Lapointe, of Montreal, is promoting a scheme to build a bridge over the Lachine canal, to be operated by two electric motors of 50 horse power each.

The corporation of Port Arthur, Ont., have purchased a motor car complete with G. E. 1000 motors from the Canadian General Electric Company.

The annual meeting of the shareholders of the City of Bermingham Tramways was held last month, at which a dividend of 5 per cent. was declared and £33,000 carried to the reserve. Mr. Jas. Ross, of Montreal, presided.

The Manitoba Gas & Electric Company have ordered from the Canadian General Electric Company all the apparatus required for their new plant, including a 6000 light direct connected single phase alternator, and a 125 light Brush arc machine.

The Hamilton Radial Electric Railway Company have elected directors for the ensuing year as follows: A. Turner, President ; W. A. Wood, Vice-President ; John Moodie, Treasurer ; Stuart Malloch, Secretary ; James Dickson, Adam Zimmerman.

At a recent meeting of the Board of Canadian Underwriters, the best method of securing proper insulation of electric wires was discussed and various suggestions made. In Western Ontario there is an inspection, but in Eastern Ontario and Quebec there is none. A committee was appointed to report at the June meeting.

Mr. J. R. Scott, of Napanee, has placed the order for electrical apparatus for his transmission plant with the Canadian General Electric Company. The generator will have a capacity of 100 kilowatts and will be of the revolving field type, with stationary armature, wound for 4000 volts, three phase. The distance from the generating station to Napanee is 8 miles.

It is announced that the Chinese goverament has decided to construct an electric tramway to Pekin, the contract being given to the Japanese branch of the German firm, Siemens & Halske. An engineer will be despatched by Siemens & Halske, of the Tokio branch, to supervise the work. The electric tramway will run from the terminus of the government railway to the wall of Pekin.

The city engineer of Toronto has been negotiating with a company of Buffalo capitalists for the transmission of power to Toronto. The company offer to supply electric energy at $40 per horse power per year if the city guarantees that it will use 10,000 horse power. The company purposes to operate from a point 30 miles nearer Toronto than the Falls. The city could scarcely guarantee to take that amount of power.

Mr. Elisha Moore, of Meductic, York county, N.B., has invented an alternating switch for street railways, which can be operated from the car by simply pressing a button. The device obviates the necessity of stopping the car and does away with switchmen, which means a great saving to railway companies. Mr. Moore has had his device patented both in Canada and the United States, and will ask for European patents.

The shareholders of the Hamilton, Grimsby and Beamsville railway held their quarterly meeting recently. The quarterly financial statement, as presented by Superintendent Nelles, showed an increase of 10 per cent. in gross earnings over those of the corresponding period of last year. The directors were empowered to issue debentures to pay off the floating debt of $20,000. The present debenture debt of the road is $85,000, payable in thirty years.

A special general meeting of the shareholders of the Quebec, Montmorency and Charlevoix Railway Company will be held in Quebec on May 14th, when the following matters will be considered: The acquisition of the franchise and property of the Quebec District Railway Company ; the conversion of the existing line of the company between Quebec and Cape Tourmente into a line operated either in whole or in part by electricity ; the construction of a branch line from Quebec to the west side of the Falls of Montmorency, operated by electricity.

The appeals of the Montreal Street Railway Company from the judgments of the Superior Court, awarding Mr. Jacquemin $300 for injuries resulting from being struck by a street car while crossing Craig street, in December, 1895, and Miss Chartier damages for injuries resulting from a similar accident on Notre Dame street, were last week dismissed by the Court of Appeal, the decision in each case being based upon the violation by the Street Railway Company's employees of the city by-law ordering that the speed of the cars must never exceed eight miles per hour, and that at all street crossings cars must be slowed up to the pace of a horse walking. The court held that as long as this by-law remained in force it would have to be observed, and the company will have to be held responsible for all damages and accidents resulting from its violation.

CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. VIII. JUNE, 1898 No. 6.

INSPECTION OF THE CATARACT POWER COMPANY'S WORKS.

MUCH interest has been taken in the scheme of the Cataract Power Company to transmit electric energy from St. Catharines to Hamilton, owing to the fact that it is the first attempt in Canada to transmit current a distance of 35 miles. Such an undertaking naturally embodies many interesting engineering features, and difficulties must be overcome which had not heretofore been met with. The promoters of the above company are Hon. J. M. Gibson, James Dixon, John Moodie, J. W. Sutherland, John Patterson and E. B. Patterson, all of Hamilton, the latter being the originator of the project. It is to these gentlemen that credit is due for the enterprise and courage shown in financing the undertaking.

With the object of witnessing the progress that had been made a representative of the ELECTRICAL NEWS recently visited the works, now in course of construction, and found that within one month the entire project will probably be completed.

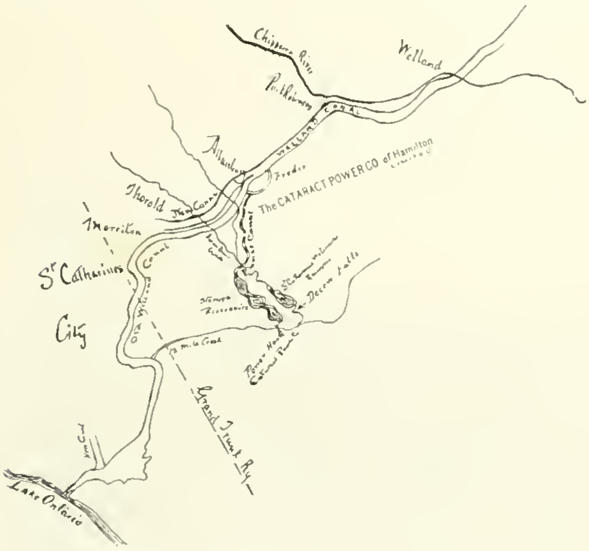


DIAGRAM SHOWING SOURCE OF SUPPLY AND PROPOSED CANAL—CATARACT POWER COMPANY'S WORKS.

To give an understanding of the scheme, it should be said that the company propose to obtain the water supply from the old Welland canal at Allanburg, and carry it by means of an artificial channel four and one-half miles in length to the brow of the mountain overlooking Twelve-Mile Creek, just east of DeCew Falls, and about two miles from St. Catharines. From the escarpment of the hill the water will be led down the face of the cliff by a huge steel pipe, the fall being 275 feet. At the foot of the hill will be located the power house, where the current will be generated and transmitted to the transformer station at Hamilton for distribution for lighting and power purposes.

Returning to the source of supply, it is scarcely necessary to explain that the Welland canal was constructed about forty years ago for the purposes of navigation, connecting Lake Ontario with Lake Erie, and being about twenty-seven miles in length. In less than twenty years afterwards it was found to be too narrow for the large vessels then sailing the lakes, and a new canal was built for the greater portion of the distance, joining the old canal near the village of Allanburg. It is almost at this junction that the canal is tapped to permit of the water being utilized for the generation of electricity, which in turn provides the motive power for industries in a city nearly forty miles distant. It will be seen that a constant supply of water is assured.

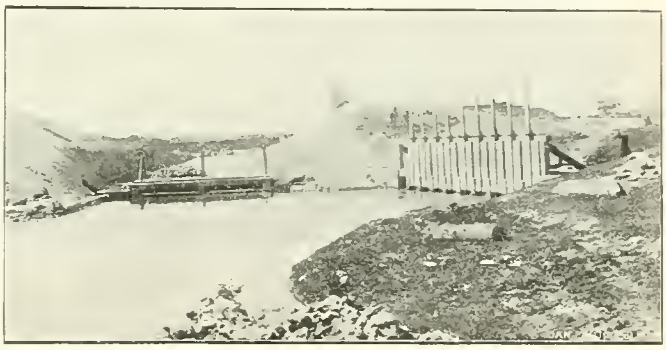


FIG. 1.—CATARACT POWER COMPANY—HEAD GATES.

At the intake we find constructed the necessary head gates, of which there are two. These are shown in Fig. 1. From the head gates the water is conducted through an artificial channel or canal, as before stated, the first section of this work being also shown in Fig. 1. Work on this canal was commenced in November last, but had to be suspended during the winter months, as it was found impossible to make the banks watertight owing to the frost. Proceeding along the canal, we find some 200 men, with teams, engaged in construction, filling in and excavating. Incidentally, it might be mentioned that the work has proved a boon to the farmers in the vicinity, who, besides selling at a good price the land necessary for right of way, are reaping additional benefit in the way of employment. The building of the canal necessitated the removal of immense quantities of earth, the required excavating

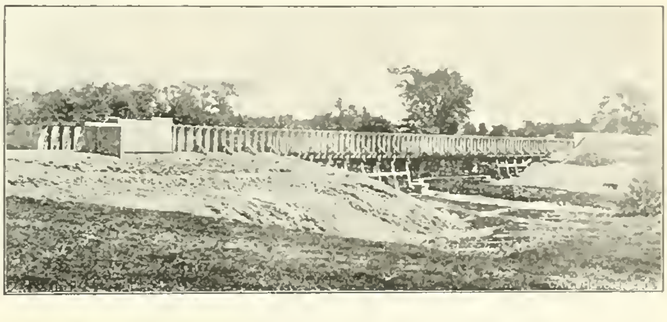


FIG. 2.—AQUEDUCT OVER BEAVER DAM CREEK.

being about equal to the filling in. The heaviest cut was about 18 feet. For a distance of two miles from the intake the canal is now practically completed. Coming to the Beaver Dam creek at Miller's farm, about two miles from Allanburg, we observe a large aqueduct nearing completion for the purpose of carrying the water across the creek (see Fig 2). This is a wooden flume, 600 feet in length, 450 feet in the clear, inside diameter 8 × 8 feet, and supported by a steel truss. The top of the flume is two feet below the level of the canal, thus ensuring a constant pressure.

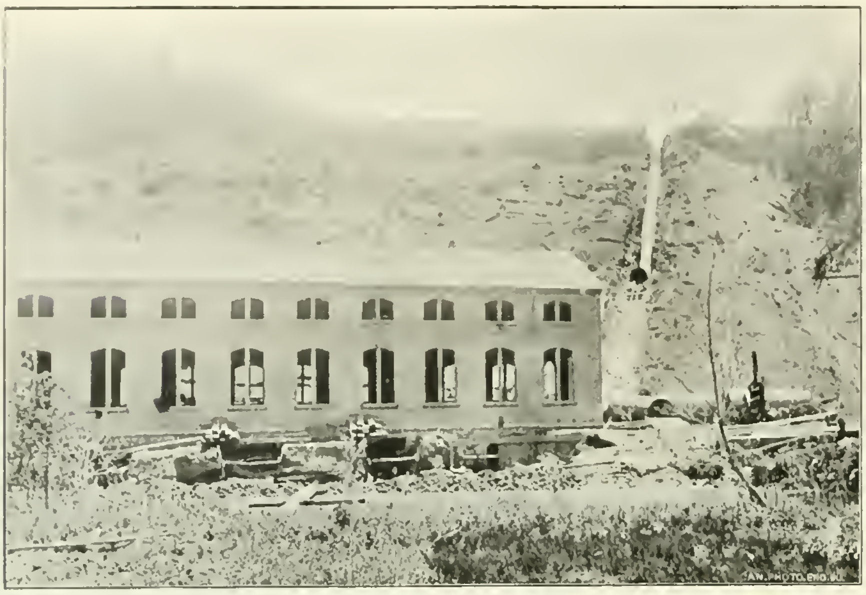


FIG. 3. CATARACT POWER COMPANY—POWER HOUSE AND PIPE LINE.

From this flume to the brow of the mountain there is considerable work yet to be completed, and numerous small bridges are in course of construction. It is the intention to have three large storage basins, one of which is completed. These will contain sufficient water for two days' operation, and will remove the danger from frazil, or small particles of ice getting into the water wheels. There will also be built, at the brow of the mountain, a concrete wall 600 feet in length and 15 feet high.

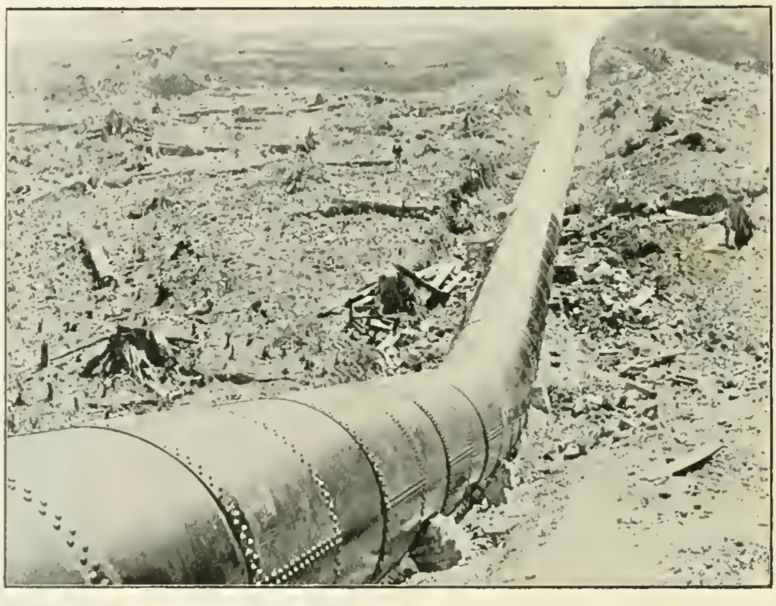


FIG. 4.—CATARACT POWER COMPANY—PIPE LINE, SHOWING HEEL.

At this point we reach the most interesting portion of the work. After cutting away the bush for several hundred feet in width, a cutting 38 feet deep and 14 feet wide was made in the rock at the top of the bank, in which will be placed the pipe line. This is shown in Fig. 3, but the correct impression can only be gained by remembering that the distance from the top of the mountain to the base of the power house is 900 feet, and the fall in that distance about 275 feet. This gives a head nearly double that of Niagara Falls, and a pressure of 135 pounds to the square inch.

The construction of the pipe line is very interesting. The heel is about two-thirds of the way down, and is shown in Fig. 4. Only a portion of the pipe is yet in position, but it is all on the ground ready to be placed. The foundation for the pipe line is made of stone, with a pier and drain every 12 feet. At the commencement the pipe is three-eighths of an inch in thickness, gradually increasing to one inch. It is a circular steel tube, 900 feet in length, the first section being 9 feet in diameter, then 8 ft. 6 in., 8 ft., and 7 ft. 6 in. to end. It was rolled and put together by the Hamilton Bridge Company, and is a creditable piece of work.

The power house is located on the south bank of the Twelve-Mile creek, into which the water will discharge direct, the points of discharge being shown in Fig. 3. Workmen are still engaged on construction, although the exterior presents a completed appearance. It is 175 × 40 feet, the walls 30 feet in height, the framework being of steel filled in with brick. The roof is covered with lap seam metal. The floor is of concrete three inches thick, but where the generators and turbines will be located it will be laid to a depth of 12 feet. It is intended to finish the interior of the power house in white. No machinery has as yet been installed except a large travelling crane capable of carrying up to 20 tons. The generators, of which there will be four, will be located on the north side, as well as two exciters. The dynamos will, it is said, weigh 67 tons each. All the electrical apparatus, including dynamos, transformers, etc., is now nearing completion at the works of the Royal Electric Company, Montreal.

The water wheels have been manufactured by the the Stilwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and will be placed in position at once. They are necessarily of special design, with steel fly wheels weighing 7½ tons each, the total weight of case and turbine being 30 tons. The current will be generated at the power house at 22,500 volts, and transmitted to the transformer station at Hamilton, where it will be reduced by step-down transformers to 2,500 volts.

The pole line has been completed for a distance of about 25 miles. Cedar poles 35 feet long are being used, with heavy cross arm, and Locust wood pins, boiled in linseed oil to increase their lasting and insulating qualities. There is a neat angle iron brace on the poles, making a remarkably solid job. The insulators, which are porcelain, are tested at an enormous pressure before being placed on the line. The line consists of 4 separate strands of No. 4 B. & G. guage copper wire. The poles are placed 90 feet apart, thus necessitating the use of about 2,000.

The transformer station at Hamilton is also nearing completion. It is 50 × 100 feet, and of similar construction to the power house.

The completed work will cost in the neighborhood of $600,000. Messrs. Angus McDonald & Co., of Thorold, Ont., are the contractors for the canal, head gates, etc.; the Royal Electric Co., of Montreal, will supply the electric machinery; Messrs. Lowe & Farrell, of Hamilton, the pole line, with Mr. Woodman in charge of construction. Mr. H. R. Leyden, late of the Royal Electric Co., is general manager of the company; Mr. Wm. Kennedy, of Montreal, hydraulic engineer; Mr. T. E. Hillman, engineer in charge; and Mr. C. W. Moody, superintendent of construction of pipe line and power house.

The company expect to transmit power regularly to Hamilton before the close of July. In a later issue we expect to give a more detailed description of this interesting engineering work.

MR. F. C. ARMSTRONG.

Mr. F. C. Armstrong, general agent of the Canadian General Electric Co., has resigned from the staff of that company, having accepted an appointment to fill a similar position in connection with the electrical department of Dick, Kerr & Co., Limited, the well-known engineering and contracting firm of London, England.

Mr. Armstrong, who is well known in his official capacity to the electrical fraternity throughout the Dominion, is a Canadian by birth, and was educated under Dr. Tassie at Peterboro', Ont., and at Toronto University.

Mr. F. C. Armstrong.

He engaged in electrical work after leaving the University in 1889, and spent three years in those pioneer days of the industry in construction and engineering work.

Since 1892 he has been identified with the Canadian General Electric Co., and in the important position which he has filled has obtained a wide experience in electrical engineering and business matters, which should be of the greatest service to him in his new and more extended field.

Mr. Armstrong's departure will be felt as a loss by the members of the Canadian Electrical Association, to the success of which he has largely contributed by the preparation of serviceable papers, and as a member of the Executive Committee.

TO READERS.

This number of the ELECTRICAL NEWS contains the announcements of a large number of the leading manufacturers of electrical and steam engineering apparatus and supplies. Our readers are asked to peruse carefully the advertising pages, and when in need of goods of the character mentioned, to communicate with advertisers, mentioning their advertisements in this journal. This will be appreciated both by advertisers and the publisher.

THE MOOTED WIRELESS TELEGRAPHS.

By D. H. Keeley, M.I.E.E., A M Can.Soc.C.E.

A study of the published accounts of investigations made in the field of wireless telegraphy perhaps reasonably leads one to the conclusion that the different systems are after all identical in principle and dependent for their operation upon the effects purely and solely of electro-magnetic induction. Once this conclusion is arrived at, one might well pause to question the reasonableness of great expectations from such means of communicating actuating influences between points more or less widely separated.

It will perhaps serve a useful purpose to go over the ground from the writer's point of view, because, if it be not altogether incorrect, it may occasion some fresh arguments, and thus help to put the subject on a yet broader basis for treatment.

CURRENT INDUCTION, PURE AND SIMPLE.

To start from the beginning: Faraday's researches produced the induction coil, that in its more efficient form takes the shape of our modern transformer. The primary and secondary coils are wound on a common core, or, in the absence of a core, are in such juxtaposition that the lines of force begotten by one coil pass through and embrace the other. The effect of a pulsation of E.M.F. through either is the momentary creation of a magnetic field, which in its rise and subsidence produces in the other coil precisely the same effect as would the momentary insertion into and withdrawal from it of a permanent magnet of the same power. That being so, it follows that if the coils are axially separated a given distance—thus permitting some of the lines of force created by the primary to complete their circuit short of the secondary—there is producible in the latter the effect of the introduction and withdrawal of a magnet of such reduced strength as is represented by the rest of the lines of force that are projected through and embrace it.

It seems this transmitted influence is subject to the same law as that governing the transmission of light, the intensity being inversely as the square of the distance from the source, so that, if at a given distance a certain effect is produced, it calls for four times the power at the source to produce the same effect at twice the distance, and sixteen times the power at the source to produce the same effect at four times the distance, and so on. It is then readily conceivable that to produce a measurable effect at a very considerable distance, the energy required to be applied to the primary must be enormous. Then, too, the greater distance we put between the coils the more nearly equi-distant they become, comparatively, between all their parts; and in the absence of an actual core conducting the lines of force, some of these latter will pass outside the distant coil and neutralize a corresponding number passing within.

Obviously the simplest way to meet this condition is to enlarge the diameter of the coils, so as to preserve a distinctive difference between the distances at which the respective sides of the two coils stand in relation to each other. Equally obvious, however, this expedient has but narrow limitations.

An experiment in this direction, perhaps on the largest scale ever attempted, is given an account of by Mr. C. A. Stevenson in The Electrician, London, August 3, 1894, Vol. XXXIII, P. 388. It was proposed to establish communication between North Unst light-house, off the coast of Scotland, and the mainland—a distance across the water of one-half mile—and apparatus was got up to demonstrate what was required. Two huge coils "of nine turns of No. 8 iron wire in each coil, the coils being 200 yards in diameter," and presenting a resistance of 24 ohms, were laid down somewhere between Glasgow and Edinburgh at a distance apart of 850 yards. The applied current varied from one-half to one ampere, and signals (received in a telephone) were transmitted satisfactorily, the effect being of course better as the strength of the current was increased.

In experiments such as these, the practice has been to apply a rapidly alternating current to the primary coil, which produces in the distant secondary coil currents of sufficient strength to cause in a telephone included in its circuit a humming sound that can, by means of a key at the sending end, be set up and stopped at will, thus affording the elements of the Morse code, whereby the telegraphing is accomplished.

The unwieldiness of such apparatus as this, as well as the limitations of its application, made it manifest that something further must be accomplished before wireless telegraphy could be regarded as on the way to practical achievement.

HERTZ WAVES.

Was there anything left unconsidered in working the idea up to the stage arrived at in the foregoing?

We can best look into this question by returning to a consideration of first principles. Let us first consider one of the coils—simply a wire wound in many convolutions. In early text-books it was called a MULTIPLIER a multiplier of the effect that was referable to the employment of a single convolution. Let us take then a single convolution. If through this single turn of wire we pass a current of 10 amperes, we have 10 ampere turns; and since M.M.F. is proportional to ampere turns, we will by this single convolution be enabled to produce an electro-magnetic effect equal to that of a coil of 20 turns, to which we apply a current of half an ampere? Grant this. Then the single convolution is an important basis to start out from. In fact, one at once rises to the conception of a current so powerful that in passing through a single convolution would produce a magnetic field so intense as to project lines of force for unlimited distances.

But why stop at a convolution? If a single complete turn can do so much, it stands to reason a part of a turn or say one side of the square, if the core space is quadrangular—will be proportionately effective.

Seeing then that a magnetic field is obtainable by the passing of a current along a straight wire, might we not go further, dispense with the wire altogether, and by causing the current to pass along an imaginary path, as across an air-gap, obtain likewise on all sides of this path that self-same magnetic field? It seems rational to suppose so. And if this whole line of reasoning is rational, might it not be admissable to assume that this was the road that led to the evolution of the Hertz Oscillator (see note 1) which to all interests and purposes fulfills this function of passing the current along an imaginary path (between the knobs of the spark gap of the machine) and projecting the magnetic lines of force in the way suggested. If this is correct, then one might readily believe that the alleged Hertz waves, about which so much has been heard lately in connection with the wireless telegraph experiments, are not Hertz waves at all. These latter are declared to be something distinctively peculiar and directly emanating solely from the spark gap of the apparatus. They may be a characteristic of the spark itself, belonging to another sphere of research. The great difference is that the effects we are dealing with here are apparently not confined to the spark gap, but are simply incidental to the passage of the current across the gap and common to all parts of the circuit.

If these effects have been mistaken for those attributable to Hertz waves proper, the chances are that, the distinction being suggested, the methods of attempting to utilize them will undergo some modification.

MARCONI'S ADAPTATION.

The most frequently mentioned personality in connection with the wireless telegraph of late is the clever student Marconi, who, with the co-operation of Mr. Preece, is exploiting and experimenting on an elaborate scale in England with an apparatus of his own that he is understood to describe as a refinement of what has heretofore been employed by others in the field. Hertz waves—influences directly projected from the spark gap—are the suppositions (or actual?) basis of his transmission. The receiver, a unique and original combination of ordinary Morse instruments, with a device that turns to account some peculiarities of metallic particles, and descriptively called a "coherer" (name due to Dr. Lodge, though he says he gave it to a different contrivance; see note 2), that is responsive to the feeblest magnetic influence. For description of this apparatus see references given in note 3. It is with his receiver maybe that Marconi's name will pass down to our distant posterity. He has been able, it appears, to telegraph over distances ranging from 9 to 20 miles with this machinery. Most all accounts, however, mark the performance as rather unreliable, still there is no gainsaying the wonderfulness of the achievement. The oddest thing of it all is, that despite the view that is understood to obtain with him as regards the nature of Hertz waves, the latest accounts represent that the greater distances are spanned and stronger effects produced by the employment of kites or balloons carrying terminal plates leading to the respective instruments.

Now, if the transmitted influences are projected direct from the spark gap, what on earth can the elevated terminal extension effect? The recourse thus had seems to support the view hereinbefore advanced. For if, during the passage of the spark across the gap, a given M.M.F. is produced, it must be that all parts of the circuit contribute to this production. The terminal plate, at the transmitting station, and its connecting wire take a part of the charge as well as any other part of the contrivance. Then the wire being for most part high above ground and nearly perpendicular to it, affords very little inductive capacity, and there is possibly no retardation at all in it; so that while the spark is passing between the knobs of the machine the terminal plate discharges, and this connecting wire for the instant has a flow of current down its length just as if it were part of an actual circuit, and its electro magnetic effects are probably more widespread than those due to the operation of other parts of the outfit.

If this is the explanation of the improved results it opens up a wide prospect for the simplification and permanency of the signalling plant.

POSSIBILITIES AHEAD.

Something remarkable has already been accomplished by those who have labored to bring about the results we have now in hand. But having grown accustomed to the marvellousness of it all, one can read with patience the arguments lately advanced as to the utter impracticability of adopting the system at its present stage for any actual service. The expedient of employing kites and balloons to help the matter out is regarded as the worst feature of the whole. It seems to be overlooked that in practice these would be replaced by some high towers and a hill or two at moderate range. However, if what is advanced in the foregoing has any scientific foundation, the necessity for extraordinarily high acrid exposures does not really exist.

An important circumstance seems to warrant this latter conclusion, as one can readily conceive, in view of it, that it is the wire itself more than its kite suspension that is efficacious. Let it be stated that, in offering the suggestion contained in the foregoing as to the part played by the kite-supported terminal plate and wire, it is reasoned that the volume of current passing down that single wire at the instant of discharge cannot easily be compared with the current that coursed through the big coil in the experiment described in the earlier part of this paper. Whence, then, its assumed widespread effects? Might they not be due to the suddenness with which the impulse moves? We have, on the one hand, a coil self-inductive and sluggish, as compared on the other hand with a single wire free from retardation. The lightning speed of the discharge may do more execution along that single wire than many times the same volume of current in the hampered convolutions of the coil.

If this reasoning is sound, the line upon which further advancement is to be made is clearly indicated.

Indeed, the influence exerted by a single wire circuit at a distance, even if in rather a bad way as regards retardation, has been well demonstrated in actual practice. The instance is found recorded in The Electrician, London (12th April, 1895; vol. XXXIV., p. 723): "The cable connecting Oban with Auchnacraig having broken down, a gutta percha insulated wire 1½ miles long was run along the ground from Morven, whilst on the Isle of Mull the ordinary overhead circuit connecting Craignure with Aros was made use of; the distance intervening between the two parallel circuits was about 3½ miles. Using a vibrator as a transmitter, and a telephone as a receiver, the usual telegraphic traffic was dealt with until the cable was repaired."

Now, considering this performance in the light of the argument already offered, we would expect that if the insulated wire, instead of forming a closed circuit with alternating currents (as is implied by the "vibrator"), had been provided with a spark gap and associated with the discharge apparatus, it would have been found immensly effective. It is the seeming warrant we have for such expectations that should give the single wire first place in the equipment of the signalling station of the future.

There are two or three important points to be borne in mind in considering the possibilities of the wireless telegraph from the standpoint of practice. The system, unless capable of a multiplication of "lines" of communication, will be useless for any extensive application. To be reliable the apparatus must not be over-sensitive; if it can be made adjustable, and if near proximity will admit of wide range of adjustment, rendering the receiver insensible to interferences, a rough adjustment to this end should be chosen, even at the cost of numerous relay plants or stations. Then, too, these latter will have to be automatic.

This is a heavy bill of requirements, and a lot of engineering will have to be performed ere it can all be realized.

The British American Corporation of Rossland are pushing the development of their properties to the fullest possible extent. The Jenckes Machine Co. of Sherbrooke, through their Rossland branch, have supplied them with special pumping apparatus for their Nickel Plate and Columbia and Kootenay mines.

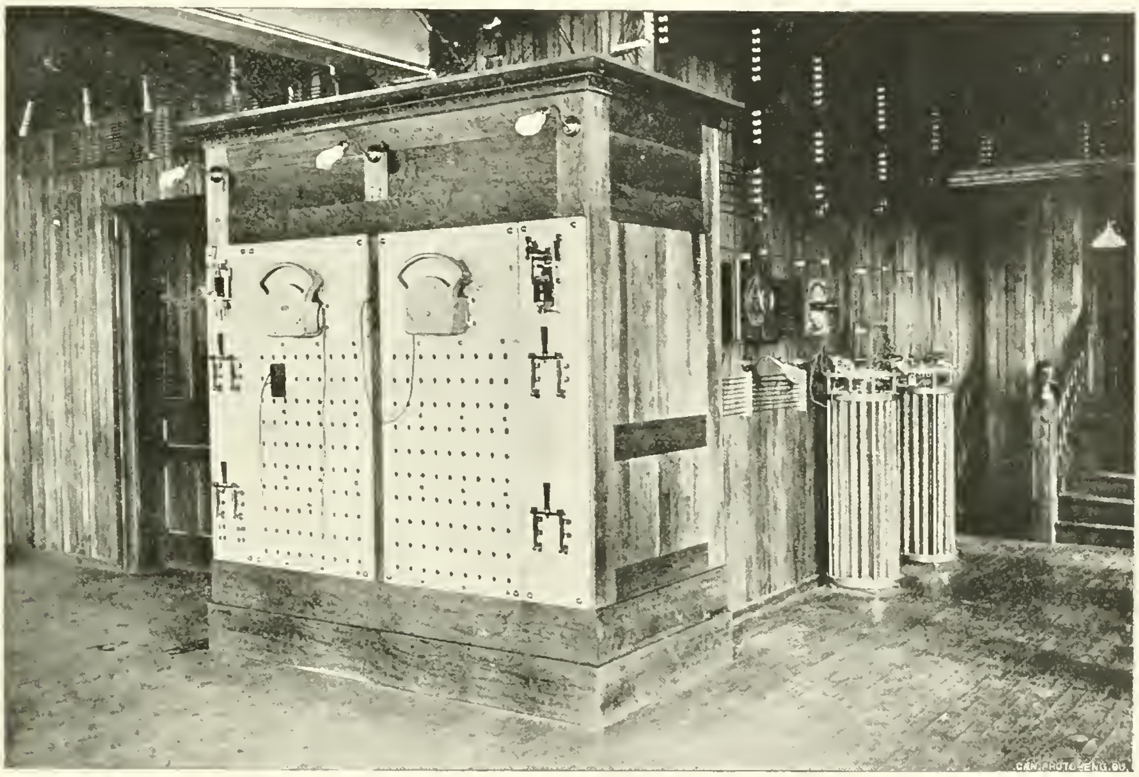
NOTES.—1. The Electrician, London, Vol. XXXIII., p. 153, contains descriptions by Dr. Lodge.
2. The Electrical Review, London, Vol. XLII., Art. Physical Society, p. 160.
3. The Electrical World, New York, Vol. XXXI, p. 17.

SWITCHBOARD AT SCHOOL OF PRACTICAL SCIENCE, TORONTO.

By T. R. Rosebrugh.

A switchboard for experimental purposes or for class work must, above all things, permit the greatest latitude in making connections, or, in other words, provide a high degree of "flexibility." In this respect it differs markedly from the switchboard of a power station, whose highest requirement is convenience in performing a certain definite service. This will perhaps be made clearer by example. A street railway generator is required solely for the pupose of supplying current to certain busbars, then it is either idle or appropriately connected by a switch directly to its work, and any more round-about connection would be both unnecessary and very inconvenient. On the other hand, a dynamo in a laboratory has no one duty; to-day its magnetization curve or one of its characteristic curves may be required, to-morrow it may be run as a motor to obtain its mechanical characteristic; another day its friction and iron losses may be measured. Or, to put it from the point of view of switchboard requirements, it is necessary, within reasonable limits, to be able to separately supply the fields with any current, the armature (as dynamo) with any resistance in circuit, or (as motor) with any potential difference. Evidently, under so varied conditions, all that can be done without limiting in some way the possible uses of the machine, is to provide at the switchboard two pairs of terminals, one for the armature and one for the fields. This need not necessarily mean that two pairs of terminals at the switchboard are exclusively devoted to these purposes, for by means of a branch switchboard (or its equivalent, a set of leads ending at convenient points) connection from armature and fields may be had when required, and at another time these points on the switchboard, with their attached leads, will serve for a different connection. It will thus be seen that a laboratory or general purpose switchboard should have much in common with the plug switchboard used in arc lighting. Another peculiarity of a laboratory switchboard is that the total number of connections to be provided for is likely to be many times as great as the number in use at any one time, so that to furnish every dynamo with suitable switches, rheostats and a magnetic cut-out, would result in an extremely unwieldy and expensive switchboard.

With this introduction, the arrangement of the switchboard recently constructed at the School of Practical Science may now be described. The two inner panels seen in the illustration are of marble, 2 inches thick, and 60 in. by 30 in. The arrangement of each of these panels may be understood by supposing thirty socket-sets, each of which is represented by Fig. 1, arranged in three columns of ten each; there are thus in all the six columns, *A*,*B*,*C*,*D*,*E*,*F*, numbered vertically downwards from 1 to 10. In the upright between the panels are also, similarly marked and numbered, six strips of ten jacks each, the same as are used in metallic circuit telephone switchboards. With few exceptions each lead to the switchboard descends vertically to its terminal, and all are rubber insulated and protected by tubes, which are secured together in bundles. Referring to Fig. 1, the leads are indicated as connecting to *b* and to the upper half of *c*. The sockets *a* and *b* are of copper, with a tapered hole, which passes right through. By means of a shoulder in the hole drilled through the marble, and nuts and washers behind on the threaded end of the stem of the socket, the latter may be secured in its place and the connection of the lead made to it at the same time on simply screwing up. The upper and lower contacts, *c*, are held together by being secured to flat springs, arranged in a special way. They are somewhat lipped in front, and sufficient clearance is given them in their cylindrical hole. So long as the two halves of *c* are electrically connected it will be seen that *a* and *b* are the actual terminals, and it is into these that the tapered plugs of the connectors are inserted. These connectors are simply pieces of rubber-insulated wire, of different suitable lengths, secured at



Switchboard at School of Practical Science, Toronto.

each end to the tapered plugs, and with insulating handles.

The use of a wedge consisting of two flat conductors separated by mica, each connected to a wire and suitably mounted, to introduce into a circuit already made up, an ammeter, the current coil of a wattmeter or Thomson balance, or other conductor of low resistance is borrowed from a similar device in arc switchboards. The two halves of *c* are intended to be thus forced apart when necessary, and it is our experience that absolute continuity of the circuit can always be maintained during the insertion of the ammeter, the ammeter being in parallel between the upper and lower contacts of *c* before the latter are separated. On inserting slowly, the ammeter reading increases steadily from zero to the full amount. In the illustration will be seen an adaptation of the idea which is believed to be new, a Weston shunt is enclosed in an insulating box, from which projects a wedge of two conductors insulated by mica, one secured to each terminal of the shunt. The branch wires to the Weston ammeter, of range 200 amperes, at the top of the left panel, are protected by a rubber tube. In this way the extra resistance brought in by the ammeter is reduced to the least possible. The illustration shows the Weston shunt in the *c* socket of circuit *A*2. In this way one ammeter may be used on every direct current circuit on the board and changes made if necessary as quickly as readings can be taken. If the direction of the current is not right for the ammeter a reversal of the shunt immediately corrects this. Advantage may be taken of this to mark one end of the shunt and thus use it to distinguish instantly the polarity of any current. Two pairs of circuits within reach also allow wedge connectors to be used to obtain current for any other ammeter or wattmeter which may be placed on bracket desks near by. Referring again to Fig 1., *p* and *q* indicate small rubber insulated pressure wires which lead to two contacts in the jack of the same letter and number, mentioned before ; thus but for exceptions there would be sixty pairs of such wires. To connect with these jacks three "cords" are brought through the central upright, these terminate each in a metallic circuit plug which may be inserted into any one of the sixty jacks and thereby effectively prolong the corresponding pair of pressure wires to the distant ends of the two light flexible conductors which the "cord" contains. Two of the three lead to the bracket desks already mentioned, where they are intended for voltmeters and the pressure coils of wattmeters. The other one returns again to a reversing switch in the space just below the jacks (a small double throw switch adapted for the purpose) ; from this switch wires are continued to the Weston direct current voltmeter reading to 150 volts, on the right hand panel.

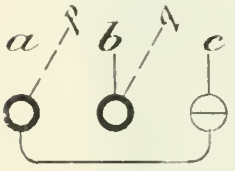


Fig. 1.

By this means the voltmeter also may be quickly transferred from one pair of terminals to another and measurements made of potential difference, the polarity being indicated by the position of the reversing switch when reading. When alternating current is used one of the two cords just mentioned must be employed. Suppose now that it is required to measure the power absorbed by the circuit *E*4 ; a suitable wattmeter being connected to the pressure and current leads it is now only necessary to insert the wedge plug in *E*4*c*, and the "metacllic circuit plug" in jack *E*4.

Provision has been made for several connections to be simultaneously made to the city incandescent circuit (110 volt) by repeating this in five socket sets. When it is desired to connect in parallel in any other case this is done by the arrangement of paralleling bars shown in Fig. 2. Suppose, for instance, that *B*3 are the leads from a dynamo and *E*8, *E*9 and *E*10 rheostats, and it is desired to absorb the power of the dynamo in these rheostats in parallel, then on connecting *B*3 to *C*6 and connecting *C*7, *C*8 and *C*9 to *E*8, *E*9 and *E*10 respectively (i.e. *a* to *a* and *b* to *b* in each case, remembering that all but the terminals shown in Fig. 2 are like Fig. 1) it will be found on tracing out the connection that they are parallel as desired. A study of Fig. 2 will show that effectively all the *a* connections are on one bar just as the *b* connections are, thus the dynamo and rheostats have their terminals at two common points. The advantage of the arrangement of the figure, however, is that current and power measurements are made possible in all the parallel branches. The other set *D* provides for the possibility of another paralleling operation being conducted at the same time, or by joining the two sets, for paralleling as many as five paths.

But another use may be made of this double set ; suppose it is desired to operate a three-phase induction motor from the three-phase terminals of a rotary transformer, and at the same time to measure the electrical power supplied to the motor. Connect the three rotary transformer leads to *C*6*a*, *C*6*b*, and *D*6*a*, and the three motor leads to *C*7*a*, *C*7*b*, and *D*7*a*, interchanging any pair of either if the direction of revolution is not right ; this is sufficient for the operation of the motor. To measure the power, however, run a connector from either of the remaining *b* terminals on the *C* side to one of the *b* terminals on the *D* side, then on introducing, as already described, pressure and current connectors at the same time on circuit *C*6 and reading on a properly connected wattmeter, then immediately moving both wedge and metallic circuit plug to the corresponding *D*6 connections and reading again, the sum of the two readings gives the power (subtracting if reversal is necessary to secure a reading on the scale). The same method of measurement would hold good wherever three wires are used, whatever the system, symmetrical three phase, monocyclic, three wire alternating or direct. The general utility of the jacks for the purpose may be criticized, but here the circuits being limited to 150 volts no danger is felt from this source.

As only a few circuits are likely to be in use at once in a laboratory, only a relatively small number of switches need be provided. These are shown on the outer marble slabs and are double pole, one being double throw and the other single throw. While fuse blocks are arranged behind the switchboard on all circuits where they are needed, there are also two magnetic cut-outs, an "I.T.E." and a "cutter," one at the head of each of the outer marble slabs. These, as well as the switches, are provided each with its own switchboard terminals, so that they may be included in any circuit when required.

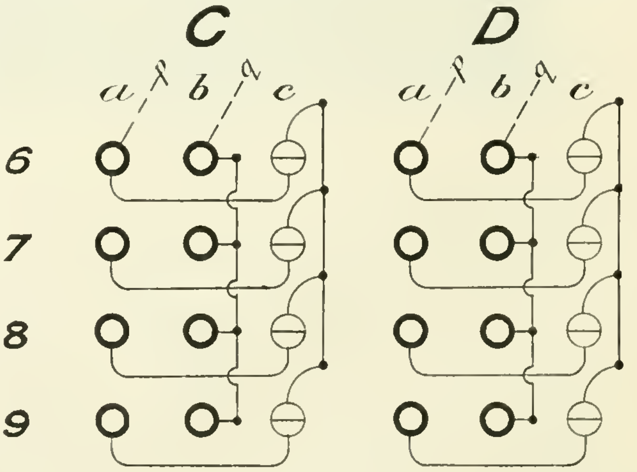
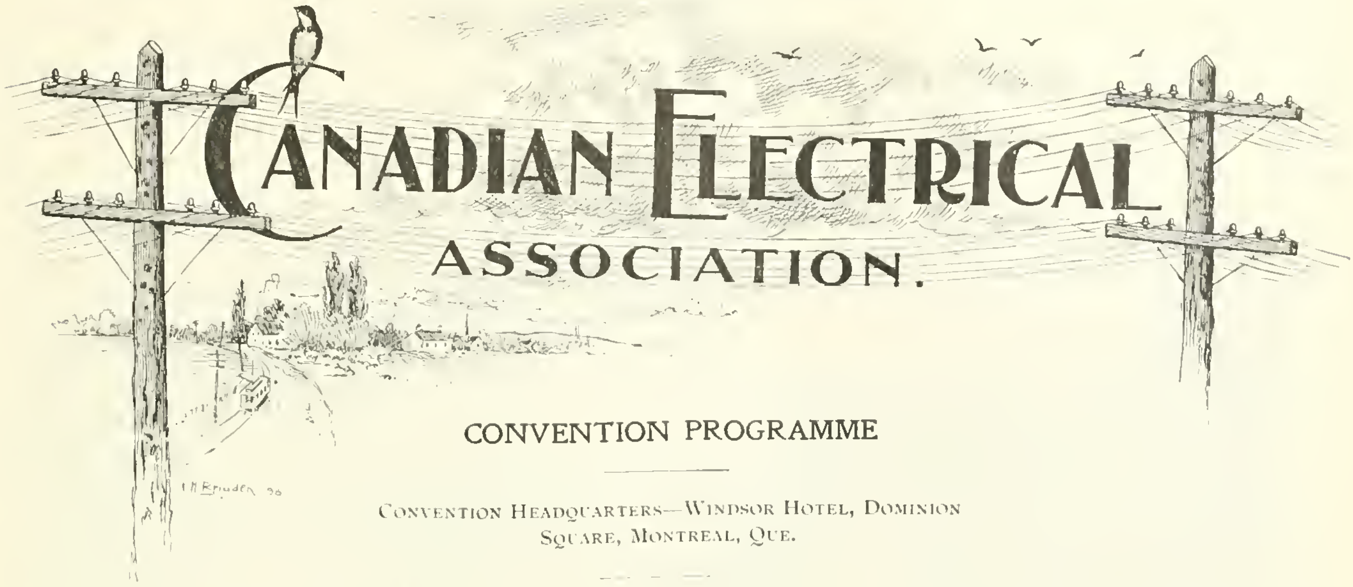


Fig. 2.

It may be added that the rather difficult drilling of the holes was done by the Messrs. Fensom, the brass work fitted by the Toronto Electrical Works, and the switches and outer marble slabs supplied by the Royal Electric Co. The wiring was done by Mr. A. Sanderson.



CANADIAN ELECTRICAL ASSOCIATION.

CONVENTION PROGRAMME

CONVENTION HEADQUARTERS—WINDSOR HOTEL, DOMINION SQUARE, MONTREAL, QUE.

BUSINESS PROGRAMME.

TUESDAY, JUNE 28TH.

9.30 A.M. Meeting of Executive Committee.

10.00 A.M. Opening of first session in Convention Hall, Windsor Hotel.
President's Address.
Reading Minutes of last Meeting.
Secretary-Treasurer's Report.
Reports of Committees and General Business.

2.00 P.M. General Business.
Presentation of Papers.
Discussion.

WEDNESDAY, JUNE 29TH.

9.00 A.M. Consideration of Reports of Committees.
Election of Standing Committees.
Selection of Place and Time of next Meeting.
General Business.
Presentation of Papers.
Discussion.

THURSDAY, JUNE 30TH.

9.30 A.M. Election of Officers.

LIST OF PAPERS.

" How to Overcome Some of the Difficulties Encountered by Central Station Men. A. A. Wright, Renfrew, Ont.

(1) " The Unconscious Ownership of an Important Key "—(A Plea for the Introduction of Goods Traffic on our Suburban Tramways).

(2) " The Quimby Screw Pump." W. T. Bonner, Montreal.

" Experiences of an Inspector." Dr. J K. Johnstone, Inspector of Electric Light, Toronto.

" The Electric Current in the Rainy River Gold Mines." W W. Hopkins, B.Sc., C E. etc.

" The Importance of Proper Methods of Illumination " F A Bowman, M.A., B E., New Glasgow, N S.

" Electric Utilization of Water Powers." Louis DeWitt Magie, Montreal.

" Economies in the Boiler Room." James Milne, Toronto.

SOCIAL FEATURES.

TUESDAY, JUNE 28TH.

7.30 P.M.—Trip around Mount Royal by special Park and Island cars, afterwards ascending Incline Railway to lookout on mountain to view the city under illumination.

WEDNESDAY, JUNE 29TH.

1.00 P.M. Visit to (1) Bell Telephone Company's new building; (2) Street Railway Company's power house; (3) power house and works of the Lachine Rapids Hydraulic & Land Company, returning to city at 7.30 p m.

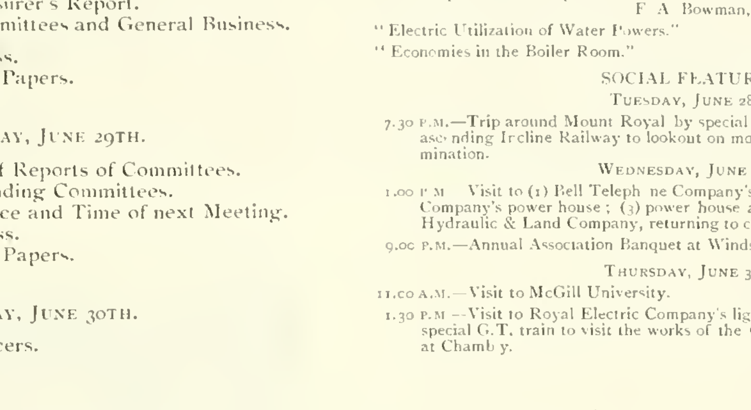
9.00 P.M.—Annual Association Banquet at Windsor Hotel.

THURSDAY, JUNE 30TH.

11.00 A.M.—Visit to McGill University.

1.30 P.M.—Visit to Royal Electric Company's lighting station and factory, then by special G.T. train to visit the works of the Chambly Manufacturing Company at Chambly.

THOSE who have the success of the Canadian Electrical Association at heart must indeed feel gratified that Montreal was chosen as the meeting place for the eighth annual convention of that society. The programme given above is one which must at once appeal to the members and the electrical fraternity as suggestive of an interesting and instructive meeting.



CONVENTION HEADQUARTERS—WINDSOR HOTEL, MONTREAL.

As will be seen, the papers to be presented cover a wide range of subjects, and it is hoped they will provoke discussion, which is one of their most useful purposes. The authors have given much time and labor to their preparation, but their true value can only be extracted by a thorough discussion of the points and claims embodied therein. Copies of the papers are now ready for distribution to members who signify their desire to be supplied with same.

The social features of the convention have been carefully arranged by the local committee, the members of which are as follows: William Thompson, consulting engineer; W. H. Browne, manager Royal Electric Company; W. B. Powell, G. N. W. Telegraph Company; L. B. McFarlane, eastern manager Bell Telephone Company; W. T. Bonner, manager Babcock & Wilcox Company; John Carroll, sec.-treas. Eugene F. Phillips Electrical Works; R. E. T. Pringle; Ald. G. W. Sadler, Sadler & Haworth, of Montreal; O. Higman, Inland Revenue Department, Ottawa; A. B. Smith, G.N.W. Telegraph Company, Toronto; F. H. Badger, superintendent Montmorency Light & Power Co., Quebec. The personnel of the committee is itself a sufficient assurance to the members of the Association that the arrangements for the entertainment of the delegates and their friends will be of the most complete character. The visit to the many electrical works, such as the Chambly and Lachine plants, the Royal Electric Company's lighting station, the Bell

Telephone building, etc., cannot fail to interest every visitor.

On the evening of the 29th inst. the annual banquet of the Association will take place at the Windsor Hotel. It will no doubt prove an altogether successful function, and the generator of pleasant memories in the minds of those who shall be privileged to attend.

VIEW OF THE DOCKS AT MONTREAL.

Altogether, the success of the convention would seem to be already assured. A good representation is expected from Ontario, while the local attendance is certain to be greater than at any previous convention. As stated in the programme, arrangements have been made with the Grand Trunk and Canadian Pacific Railway Companies for a rate of fare and one-third for the return trip. Should the present low rates continue, which now seems probable, the return ticket from Toronto will cost only about $7. This should prove a strong inducement to a good attendance.

The steps taken by some towns and cities in Ontario towards municipal ownership have been the means of increasing interest in the Canadian Electrical Association, the usefulness of which is now acknowledged. Electric light companies have become convinced of the necessity of organization in order to protect their property. There is also the problem of the insulation of electric wires, to meet the demands of the Fire Underwriters' Association. These questions are likely to be fully considered at the forthcoming convention.

THE CITY OF MONTREAL.

Situated at the head of ocean navigation, and as the commercial metropolis of the Dominion, Montreal occupies an unique position among the cities of Canada. Within its borders are located great commercial institutions ; public and educational buildings unsurpassed on the continent of America ; churches of wonderful massiveness and architectural beauty ; a number of public parks and squares ; these, with other equally important features, make the city one of the most interesting, as well as instructive, in the world.

A few words of historical reference are necessary to an understanding of the many points of interest, and of the great strides that have been made by the city in a commercial way. As all Canadians know, Montreal is built on an island formed by the Ottawa river debouching into the River St. Lawrence, at its western and eastern extremities. It was founded on the 8th of May, 1642, by Maisonneuve, a knight of the mediaeval school, 107 years after the visit of Jacques Cartier in 1535. Champlain visited the place in 1611 and founded a trading post on the site of the old Custom House Square. The first clearing for the city was made where the present custom house now stands.

Montreal surrendered to the British forces on the 8th of September, 1760, one year after the capture of Quebec. The Americans captured the city in 1775, and it was again secured by the British the following year. From that time forward the growth of the city has been well nigh phenomenal, until to-day it has a population of more than 275,000. It is said that one-half of the population is of French origin.

The principal streets of the city running east and west are Notre Dame, St. James, Craig, St. Catharine and Dorchester, and on the first three of these are located many of the principal commercial houses and public buildings. The main streets running from the river towards the mountain are St. Denis, St. Lawrence Main and Bleury. The Windsor hotel, the headquarters of the forthcoming convention, is located on the corner of Windsor and St. Catharine streets, overlooking Dominion Square, and near the C.P.R. and G. T. R. stations, of which illustrations are given in another part of this paper.

PROF. BOVEY,
Dean Faculty of Applied Science, McGill University.

The churches of Montreal are one of the greatest attractions to visitors. Foremost of these is St. Peter's Cathedral, on Dominion Square, and which may be viewed from the Windsor Hotel. It is being built after the model of St. Peter's in Rome, was commenced in 1868, and is yet in course of completion. The church Notre Dame, opposite Place d'Armes Square, is also built after the style of a church in Paris, and is said to have cost $6,000,000. The oldest church in the city is Notre Dame de Bonsecours, erected in 1771.

View of Victoria Square, Montreal.

McGill University, which is intended to be visited by the delegates to the convention, is one of the grandest educational institutions in the world. Forty-seven acres of land, on which the buildings stand, together with the sum of ten thousand pounds, was bequeathed by Hon. James McGill to the "Royal Institution for the Advancement of Learning," to establish a college for the purposes of education. With these funds the present institution was commenced, and, by donations received since, there have been erected large and thoroughly equipped buildings for the different branches of learning. The department of the Faculty of Applied Science, in which members of the Canadian Electrical Association will be most interested, consists of three separate structures—the Engineering building, the Physics building, and the workshops. Prof. Bovey, whose portrait appears on the opposite page, is Dean of this faculty, and Mr. L. A. Herdt, E.E., Ma.E., Demonstrator in Electrical Engineering, with charge of the electric light plant. A description of the electrical laboratory appeared in our May issue. We can safely predict that visitors will here find much of interest.

Boat Shooting Lachine Rapids, near Montreal.

Among the public buildings of importance in Montreal might be mentioned the Court House, Bonsecours market, and the City Hall.

The three most noted squares are the Dominion, Victoria and Place d'Armes, views of which are shown. Reference has already been made to the first of these. Victoria square is situated between McGill street and Beaver Hall hill, and upon it is a colossal bronze statue of Queen Victoria. Place d'Armes, between Notre Dame and St. James streets, is surrounded on four sides by important buildings, the New York Life, in which are the Montreal offices of this journal, forming one section. Mount Royal Park, which may be reached by the Incline railway shown in the accompanying engraving, covers 430 acres of ground, and rises over 700 feet above the level of the St. Lawrence river.

One of the most important engineering works yet undertaken, the rebuilding of the Victoria bridge, is now in progress. The old Victoria bridge, at the time of its erection in 1859, was the greatest in the world, being nearly two miles in length. It is said to have cost $6,000,000, and to have occupied nearly six years in building, though used only by the Grand Trunk Railway. The new bridge will have tracks for steam railways and electric cars, besides a road for vehicles and sidewalks for pedestrians, a feature which will be greatly appreciated by the public. During construction traffic has continued incessantly, this being made possible by the utilization of portions of the old bridge.

Incline Railway to Mount Royal Park.

ELECTRICAL FEATURES.

Electrically, Montreal is beyond doubt the most attractive city in the Dominion. It is fitting, perhaps, that reference should first be made to the electric railways, of which there are three distinct systems, viz., the Montreal Street Railway, Montreal Park and Island Railway, and Montreal Belt Line Railway. Six years ago the Montreal Street Railway was changed to electric traction, and the company have now in operation over eighty miles of road. The rolling stock consists of nearly 300 motors and trailers. The power house, on William street, is 290 x 233 feet. In the engine and dynamo room are located twelve Edison generators of 200 k. w. capacity each, six multipolar generators of 300 k.w. capacity, and a 4,500 h.p. Laurie engine installed last summer. This engine replaced six Corliss compound engines of 600 h.p. each, which were in use at the time the photograph was taken from which the accompanying illustration of the power station was made. An interesting feature of this installation is the switchboard, which is 60 feet long and 11 feet high, constructed of terra cotta lumber. The entire equipment is very complete and interesting. The offices of the company are at the corner of Craig street and Place d'Armes, Mr. F. L. Wanklyn, whose portrait we give, being general manager.

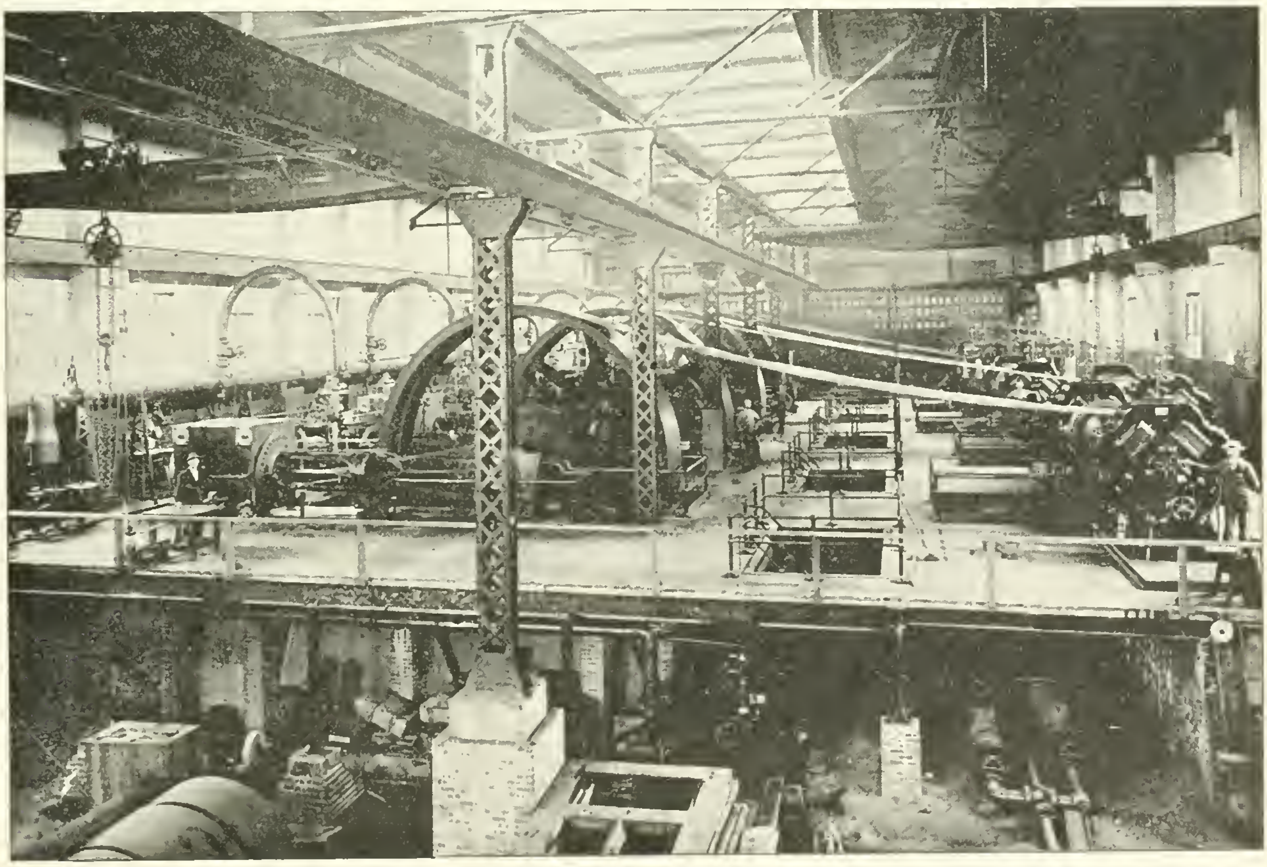
The Montreal Park and Island Railway affords the means of visiting the many beautiful suburbs of Montreal, passing, as it does, through a most picturesque country. There are two main lines, with some twenty miles of track. The Sault-au-Recollet line runs up St. Lawrence street, thence straight across the country to Sault-au-Recollet, or Back River. The Cote-des-Neiges, or Outremont line runs up Bleury street and Park avenue, through Montreal annex, Cote-des-Neiges, Mount Royal Vale, and Notre-Dame-de-Graces, making a complete circuit of both mountains and connecting with the lines of the Montreal Street Railway at Westmount. Places of interest along the route are the Monument National, Shamrock lacrosse grounds, Convent of the Sacred Heart, Hotel Dieu, Royal Victoria Hospital, Monklands, ruins of Villa Maria Convent, and numerous historical landmarks. The power station of the company is located at Mile End, although it is intended to build a larger generating station when all the proposed lines of the company have been completed. Mr. Chas. A. E. Carr, whose genial countenance is portrayed on another page, is general manager.

Place D'Armes Square, Montreal, showing Notre Dame Cathedral.

Dominion Square, Montreal.

The system of the Montreal Belt Line Railway has recently been put in operation, and comprises thirteen miles of track. It is intended to serve the lower part of Montreal Island. The line leaves the Canadian Pacific Railway at Hochelaga, passes through the municipalities of Maisonneuve, Longue Point and Point aux Trembles, and, following the course of the St. Lawrence river, reaches Bout d'Isle. At this point the cars are connected by a steam ferry with the town of Charlemagne and other points. The power house is built near the centre of the line, and contains two C.G.E. generators of 200 to 325 kilowatt, three Goldie & McCulloch compound condensing Wheelock engines, aggregating 700 h.p., with necessary boilers and other equipment. The cars comprise nine open and four closed, in addition to an electric freight locomotive. The manager of the road is Mr. J. P. Mullarky. Mr. John Rowley is superintendent, Mr. Robert Welsford, engineer, and Mr. C. H. Wright, son of Mr. A. A. Wright, of Renfrew, electrician.

MR. W. L. WANKLYN,
Manager Montreal Street Railway.



ENGINE AND DYNAMO ROOM, MONTREAL STREET RAILWAY COMPANY'S POWER HOUSE.

So much for the electric railway systems. Turning to another branch of the electrical industry, viz., light and power, we find within the city of Montreal and in its immediate vicinity the two great hydraulic-electric plants of the Chambly Manufacturing Company and the Lachine Rapids Hydraulic and Land Company, an inspection of which is included in the convention programme. Chambly is the headquarters of one of the most comprehensive power and transmission schemes yet undertaken on the continent, and which is now nearing completion. The source of power is a large concrete dam and generating station on the Richelieu river at the village of that name, 25 miles distant from Montreal. It is intended to transmit 20,000 horse power to to the city for incandescent and arc lighting and direct current motor service, the main power transmission line to end in the electric light station of the

MR. C. A. E. CARR,
Manager Montreal Park and Island Railway.

MR. WM. THOMPSON, Chairman, Montreal.

MR. W. H. BROWNE, Montreal.

MR. W. T. BONNER, Montreal.

MR. O. HIGMAN, Ottawa.

MR. L. B. McFARLANE, Montreal.

MEMBERS OF LOCAL COMMITTEE—CANADIAN ELECTRICAL ASSOCIATION CONVENTION, MONTREAL, 1898.

Royal Electric Company, by whom the work is being carried out. From early days there was a wooden dam between Richelieu village on the one side of the river and Chambly on the other. This has been replaced by a new structure, which is one of the finest examples of hydraulic engineering on the continent. It consists of a massive concrete dam 2,000 feet long, in which, as an integral part, is built the power house. The dam consists of three portions, two of which run perpendicular across the course of the river, while the third and middle part is parallel with it. In the lower third of the dam is built the power house, a structure of steel beams and brick walls, 308 x 51 feet. The upper level will contain the switchboard, controlling devices and offices. There will be 32 turbines, each 46 inches in diameter and of 660 h.p. capacity, making a total of over 21,000 h.p. Each gang of four turbines will be directly connected to a 2,000 k.w. "S.K.C." generator, giving two phase current at 60 cycles per second and generating 12,500 volts. A view of one of these generators is shown in the advertisement of the Royal Electric Company on another page. They are of the induction type, and the insulation is necessarily most massive and substantial. Among the many interesting features of this plant is the novel method of carrying the wires over the new Victoria bridge.

The works of the Lachine Rapids Hydraulic & Land Company were completed in the fall of last year. As implied by the name, the water of the Lachine rapids is utilized. The hydraulic machinery, when all is installed, will consist of 72 Victor wheels of 300 h.p., and the electrical installation of twelve 750 k.w. C.G.E. three phase generators, direct connected to six water wheels and operating at 4,400 volts at 175 revolutions. The company practically have four stations. Their substation at the corner of McCord and Seminary streets, and the Standard Light and Power Company's station both obtain power from the rapids, being equipped with direct current apparatus driven by synchronous motors. The sub-station of the Citizen's Light and Power Company at Cote St. Paul was destroyed by fire a few months ago, but is now being rebuilt. The Lachine Company also supply power to the Temple Electric Company, in which they have a controlling interest. A fine new switchboard has recently been purchased. It is made of blue Vermont marble, with specially designed switches.

The lighting and power stations of the Royal Electric Company have been entirely reconstructed on the most improved methods within the last two years. These, together with the extensive works of this company for the manufacture of electrical apparatus, will doubtless prove a special attraction to central station managers.

The fine new building of the Bell Telephone Company

ALD. G. W. SADLER, Montreal.

MR. A. B. SMITH, Toronto.

MR. W. B. POWELL, Montreal.

MR. JOHN CARROLL, Montreal.

MR. R. E. T. PRINGLE, Montreal.

MEMBERS OF LOCAL COMMITTEE—CANADIAN ELECTRICAL ASSOCIATION CONVENTION, MONTREAL, 1898.

on Notre Dame street will well repay a visit. The equipment of the exchange is most complete and up to date, as becomes the headquarters of the company. The head offices of the G.N.W. and C.P.R. Telegraph Companies, located on St. Paul street, within a block of each other, should also be visited.

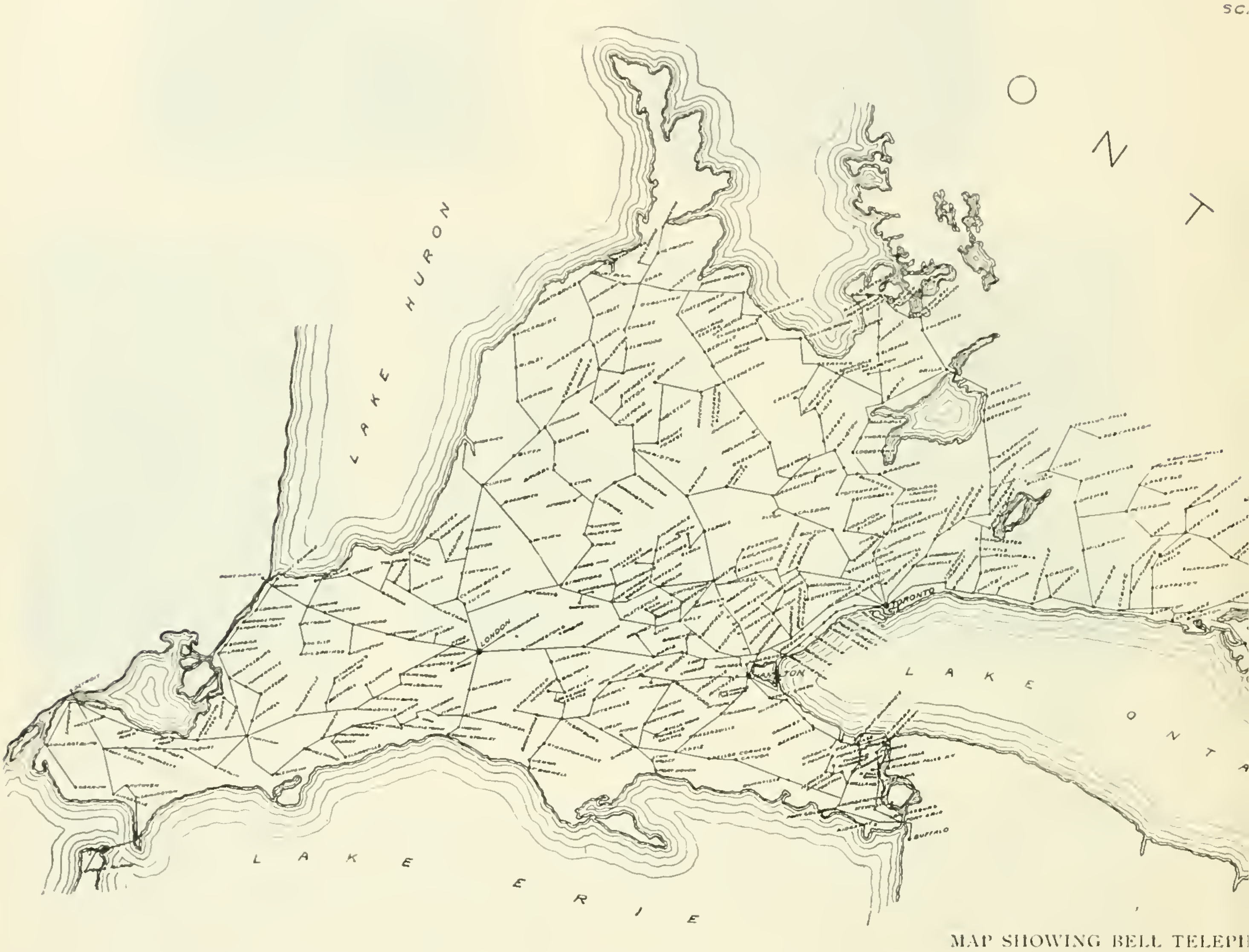
Nor should we overlook the manufacturers of and dealers in electrical supplies, who, through the medium of this journal, extend a hearty welcome to members of the Canadian Electrical Association and their friends to visit them. Ness, McLaren & Bate will be found in new premises at 419 St. James street; Royal Electric Company on Queen street; Canadian General Electric Company at 1802 Notre Dame street; R. E. T. Pringle at 216 St. James street; John Forman at 644 Craig street; Alex. Barrie & Co., manufacturer electric wires, at 589 St. Paul street; Munderloh & Company at 61 St. Sulpice street; Montreal Electric Company at 1898 Notre Dame street; the Electric Repair & Contracting Company at 621 Lagauchetiere street, and Fred Thomson & Co. at 7 Chenneville street. The factory of the Eugene F. Phillips Electrical Works, of which Mr. John Carroll is manager, is at Point St. Charles. E. A. Wallberg, sales agent for the Kingsley water tube boiler, is located in the Bell Telephone building. The J. C. McLaren Belting Company, 294 St. James street, will also keep open house during the convention.

Visitors should not fail to inspect the permanent exhibit of steam plant accessories at the offices of Babcock & Wilcox, Limited, 202 St. James street. The building is better known as the Mechanics' Institute, and is situated on the corner of St. Peter street. All Windsor and St. Lawrence, Notre Dame and P. and I. Lachine cars pass the door. In addition to installing a full sized working model of one of their forged steel boilers, erected with brick setting on structural iron foundation resting on concrete footings in the basement, Babcock & Wilcox exhibit in working order, automatic damper regulators, recording pressure and draught gauges, gauge testers, safety valves, steam traps, feed water filters, expansion joints, and all other steam plant accessories. Of the thirty odd thousand horse power of boilers listed on the official inspector's records in Montreal, Babcock & Wilcox have supplied over 8,000 h. p., or 25 per cent. At the Queen street and Sohmer Park stations of the Royal Electric Co., Montreal Street Railway, William Street Power House, Bell Telephone building, New York Life building, McGill College, Notre Dame Cathedral and many other places, visitors will find large installations of Babcock & Wilcox boilers.

Some of the natural, artificial and electrical features of Montreal have been briefly outlined in this article; there are others of equal interest. What has been written should be sufficient to induce every member of the Canadian Electrical Association to endeavor to be present at the forthcoming convention and participate in the programme which has been prepared.

BELL TELEPHONE COMPANY'S LONG DISTANCE LINES.

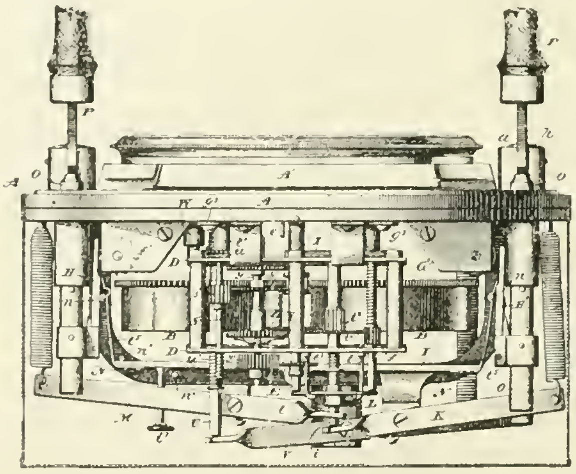
The accompanying map shows the long distance lines and offices of the Bell Telephone Company in the provinces of Ontario and Quebec, for particulars of which the reader is referred to the article in our April issue under the heading "Long Distance Telephony in Canada." The company have now in operation in these provinces 6,095 miles of poles, bearing 16,567 miles of wire. Connections have been established with the long distance system of the American Telegraph and Telephone Company and affiliated companies in the United States, affording a system of direct communication as far south as Virginia and Tennessee, and from the cities and towns of the Atlantic seaboard westward to Nebraska.



MAP SHOWING BELL TELEPH

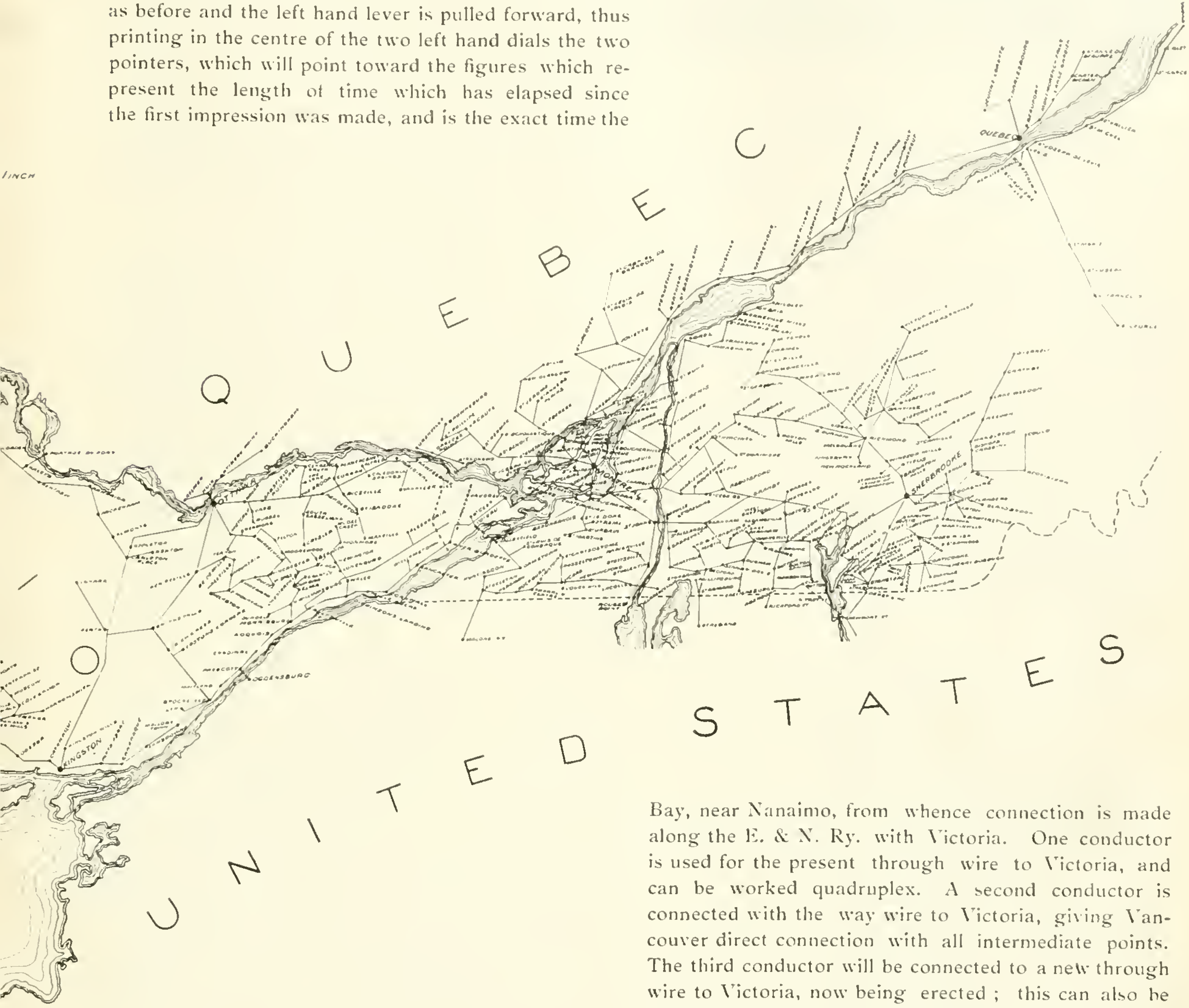
The efficient service now afforded by long distance telephone lines has been quickly recognized by the commercial world, the putting into operation of the service appearing to immediately create new business—that which could not be done either by mail or telegraph. We are informed by the Bell company that conversations are now frequent from Ottawa to Baltimore, and from Montreal to Cincinnatti, Pittsburg, Philadelphia, Chicago, Portland, Richmond, Virginia, Evanston, Illinois, and other distant points.

In order to make the service as efficient as possible, and also to ensure perfect accuracy in calculating the time for which a customer is charged, the Bell Telephone Company have recently equipped all their principal long distance exchanges in Canada with a novel but most ingenius and useful device called the calculagraph. The purpose of this little machine, of which an illustration is given below, is to check automatically the time occupied by a conversation. It is encased in a stand, the face of the machine bearing an exact resemblance to an ordinary clock. Two dials on the left indicate elapsed time; the first dial and pointer make a complete revolution in five minutes, and the smallest division represents one-quarter of a minute. The second dial and pointer make a complete revolution in one hour, and the dial is divided into periods of five minutes each. The method of using is as follows: At the beginning of a message a blank card or ticket is inserted in the slot at the front of the instrument against the guide, and is shoved to the right until it fits in the



Bell Telephone Company's Calculagraph.

corner; the right hand lever is then pushed backward and forward; this records the time of day and also makes an impression of the two dials at the left, but not of the pointers. At the conclusion of the message the ticket is again inserted in the slot in the same position as before and the left hand lever is pulled forward, thus printing in the centre of the two left hand dials the two pointers, which will point toward the figures which represent the length of time which has elapsed since the first impression was made, and is the exact time the speaker has occupied the wire. The time is guaranteed to be accurate, the clock running continually, no matter whether any person is speaking or not. The device, which has been patented, has proved a great boon to operators as well as to the company.



Y'S LONG DISTANCE LINES.

C. P. R. CABLES IN BRITISH COLUMBIA.

The telegraph business at Victoria, B. C., increased so largely during the past year that the single conductor cable across the gulf was found insufficient to carry it. Owing to some injuries received through contact with electric light wires in Vancouver, the cable could only be worked duplex. In addition to this, part of the line was built through the woods and was subject to interruptions from the severe wind storms which sweep across that district. Last winter the Canadian Pacific Railway's Telegraph Department ordered a new three conductor cable from the Telegraph Construction and Maintenance Co., London, Eng. The factory was worked night and day and the cable completed in time to go forward by the new C.P.R. steamship "Tartar," which had been purchased for the Klondyke travel.

This cable was successfully laid on April 8th, directly from the steamship, from Vancouver city to Departure Bay, near Nanaimo, from whence connection is made along the E. & N. Ry. with Victoria. One conductor is used for the present through wire to Victoria, and can be worked quadruplex. A second conductor is connected with the way wire to Victoria, giving Vancouver direct connection with all intermediate points. The third conductor will be connected to a new through wire to Victoria, now being erected; this can also be worked quadruplex, so that in emergency nine circuits can be utilized between Vancouver and Victoria. The old cable has been picked up, all faults cut out, some new single conductor cable added, and was laid on May 21st between Beecher Bay on Vancouver Island and Crescent Bay in Washington. Land lines will connect this with Victoria and Seattle, and, by the end of June, Victoria will have an alternate route. A few years ago there was a cable direct from Victoria to New Dungeness, but it had to be abandoned owing to the armour being destroyed by galvanic action, caused by copper veins in the bottom of the straits. On account of these veins the cable was not replaced, but it is hoped that the new route, via Beecher Bay, will be free from them.

The work of laying and picking up these cables was done under the superintendence of Mr. F. B. Gerrard, of the Commercial Cable Co.'s staff.

The Jenckes Machine Co., of Sherbrooke, Que., have equipped the Athabasca mine, Nelson, B.C., with complete hoisting outfit and boiler.

D. S. McArthur & Co., of Nelson, B. C., are developing their properties, and recently purchased through the Rossland branch of the Jenckes Machine Co. one of their complete hoisting plants.

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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Electric Roads in New York.

THE Metropolitan Street Railway Company, and the Third Avenue Railroad Company, of New York, have made application to the State Railroad Commission for permission to change the motive power on the various lines not now operated by electricity. It is said that these changes will cost thirty million dollars, and will apply to about 150 miles of road. It is probable that the underground conduit will be adopted. When the improvements are completed both horse and cable power will be done away with.

Central Stations As Fire Risks.

A DETAILED summary of the fire losses of Canada will, we believe, show that central stations for electric light and power are by no means undesirable risks for insurance companies. Comparatively few stations are destroyed or seriously injured by fire. Indeed it would seem that, owing to their operation at night, when the greater percentage of fires occur, the danger is to a large extent minimized. This being the case it is probable that all central station managers have not given sufficient attention to the adoption of proper methods for the prevention of fire. The Underwriters' Association is now having an inspection made of central stations in Ontario, with a view to learning how far they meet the demands of the association. It is therefore in the interest of the electrical industry that reasonable precautions against fire be taken by the owners of light and power stations. In this connection we might point out the necessity for a more thorough understanding between the Underwriters' Association and the electrical companies. While it is desirable that the demands of the underwriters should be complied with in so far as is expedient, some of their requirements are believed to cause unnecessary hardship. This not only applies to central stations, but also to electric wiring of buildings. We hope that this subject will be brought up and fully discussed at the forthcoming convention of the Canadian Electrical Association.

Electrical Conventions in Chicago.

THE National Electric Light Association and the Illinois Street Railway Association held their annual conventions in Chicago on June 7th, 8th and 9th. At the former Mr. W. McLea Walbank, of Montreal, read a paper on "The Cost of Producing Electric Power by Water Power from Lachine Rapids." A paper on "General Distribution from Central Stations by Alternating Currents," was presented by Mr. H. A. Wagner, of St. Louis, and a companion paper on "General Distribution from Central Stations by Alternating Currents," by Mr. Louis A. Ferguson, of Chicago. An interesting feature of the programme was an illustrated lecture on "Electricity Direct from Coal," by Mr. Joseph Wetzler, of New York.

Cost of Niagara Power.

IN view of the agitation by a section of the press and community in favor of attempting to bring electric power from Niagara Falls to Toronto, interest attaches to a schedule of charges recently adopted by the Cataract Power and Conduit Co. for power delivered in Buffalo, the rates being for three-phase alternating current delivered on the premises of the user at a potential of 2,200 volts:—For use not exceeding 1,000 units, two cents per unit; for use exceeding 1,000 units, but not exceeding 2,000 units, the rate shall be, for 1,000 units two cents per unit, and for the excess one and five-tenths cents per unit; for use exceeding 2,000 units, but not exceeding 3,000 units, the rate shall be, for 2,000 units one and five-tenths cents per unit, and for the excess one and two-tenths cents per unit; for use exceeding 3,000 units, but not exceeding 5,000 units, the rate shall be, for 3,000 units one and two-tenths per unit, and for the excess one cent per unit; for use exceeding 5,000 units, but not exceeding 10,000 units, the rate shall be, for 5,000 units one cent per unit, and for the excess eight-tenths of a cent per unit; for use exceeding 10,000 units, but not exceeding 20,000 units, the rate shall be, for 10,000 units eight-tenths of a cent per unit, and for the excess seventy-five hundredths of a cent per unit; for use exceeding 20,000 units, but not exceeding 40,000 units, the rate shall be, for 20,000 units seventy-five hundredths of a cent per unit, and for the excess seventenths of a cent per unit; for use exceeding 40,000 units, but not exceeding 80,000 units, the rate shall be, for 40,000 units seven-tenths of a cent per unit, and for the excess sixty-six hundredths of a cent per unit; for use exceeding 80,000 units, the rate shall be, for 80,000 units sixty-six hundredths of a cent per unit, and for the excess sixty-four hundredths of a cent per unit. There will be an additional charge for "service" of about 75 cents per horse power per month.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By Wm. Thompson.

[Article 6].

Having considered the scale forming properties of various impurities contained in natural waters, it naturally now requires our attention to be drawn to remedial measures. This we can only discuss in a general way, since conditions of use and impurities in feed waters vary so widely; it is obviously impossible to lay down any single method to suit all cases. Perfectly satisfactory results can only be obtained by individual examinations of each case, taking into consideration not only condition and nature of impurities in feed waters, but also the condition of service and style of boilers or other heating apparatus in use.

While we cannot lay down a rule and formula adapted to each case, we can, at least, intelligently discuss the nature of the reaction it is our desire to bring about, and in this way, I hope, enable the engineer to have reliable data at hand for his guidance.

As already pointed out during the early stages of these articles, the solid impurities contained in the feed water may be in either of two conditions—suspended mechanically, or held in solution. The first of these has quite as important a bearing upon final results as has the latter, and requires just as careful consideration. Since, however, matter held in mechanical suspension requires nothing but mechanical treatment or filtration to effect removal, the question does not involve any serious difficulty. The writer cannot impress too strongly, however, upon his readers the very great importance that this kind of impurity has upon formation of scale. It is comparatively easy in many districts, for various reasons, for the pumps to be continually delivering to the boilers varying quantities of finely divided clay, sand, etc., when water on surface of source of supply appears to be perfectly clear, and presence of such impurities is not even suspected until the engineer finds his boilers coated with thick scale of a most dangerous type. Where there is the slightest danger of anything like this occurring, engineers should insist upon a first-class filtering medium being placed between source of supply and boilers, and small first cost of a real first-class article of this kind will be amply repaid in a very short time.

The idea that any kind of water will do for boiler feed purposes so long as it is "wet" is far too prevalent. The presence of such impurities as are usually met with in mechanical suspension has a very important bearing on scale formation, especially so in the presence of salts of lime and magnesia, and the extraction of matter held in mechanical suspension in very many cases largely tends not only to reduce, but to actually prevent the formation of scale, and the first important requirement necessary for the building up of a good feed water is that it should be clean. As a matter of fact, insoluble matter in suspension should in no case be allowed to exceed .5 grains per gallon. If care and judgment are exercised a good filter can be easily secured, set up, and kept clean, and a very large proportion of the matter held in mechanical suspension removed.

Impurities in solution are of quite a different class, inasmuch as they cannot be extracted by mere mechanical filtration, since by being in solution in the water they will pass through the finest filter, and as a consequence before they can be extracted a change of state must take place, and they must be changed from soluble to insoluble salts, whereby they appear in condition first mentioned and in a position to be extracted by purely mechanical means.

Before proceeding to discuss how this can be brought about, I wish briefly to refer to my first article on this subject dealing with the application of electrical current for prevention of corrosion. A great deal has been claimed by various inventors and writers as to the adaptability of methods of this kind for preventing the formation of scale and effecting its removal after formation. In some instances remarkable success was attained, in many others complete failure resulted. The method has not been universally successful, nor can it be, for many reasons.

I have already pointed out that there are certain scales such as those formed from the carbonates of lime and magnesia that are not very compact, but porous and easily penetrated by the water, consequently the water easily reaches the boiler shell, and when brought into contact with a voltaic current decomposition of the water as an electrolyte sets in, and the hydrogen gas bubbles which form on the iron plate very soon form a thin film of hydrogen gas, interposed between the scale and the plate; as a consequence, scale having poor adhesive qualities soon peels off. Such a result cannot be obtained except in the presence of fairly pure carbonate scale.

Other scales such as are formed from carbonate of lime and organic matter, sulphate of lime, etc., are hard, compact, tenacious in their hold upon iron, and quite impervious to water. Under such conditions as these decomposition of the water cannot take place in contact with the plate, and consequently the thin film of hydrogen gas cannot form between the boiler and the plate.

The methods usually adopted to prevent the formation of scale are to render the scale forming impurities insoluble by physical or chemical changes, thus precipitating impurities either previous to or after reaching boilers. It will be readily seen that before treatment of this kind can be effective certain precautions must be taken.

First—precipitate so formed must be of such a nature that it will not harden or bind together into scale; next, chemical compounds added must also be of such a nature that they themselves will neither form scale nor yet attack the boiler parts, as with either of these it is quite possible to get, as a final result, a condition of affairs worse in effect than would result from impurities originally existing.

A process for softening water, originating from Scotland and known as the Porter-Clark process, may here be referred to as a very useful method for improving feed waters containing the soluble bi-carbonates of lime and magnesia.

This method consists essentially in adding to the feed water a quantity of lime water which first combines with free carbonic acid to form bi-carbonate of lime, and then combining with the excess of carbonic acid contained in the bi-carbonate thus formed as with the excess of carbonic acid already existing as bi-carbonate of lime and magnesia—this final reaction is represented by following equation (in the case of lime salts, a similar reaction taking place with magnesia.)

$$\begin{array}{ccccccc} \text{Lime Water.} & & \text{Bi-Carbonate of Lime.} & & \text{Carbonate of Lime.} & & \text{Water.} \\ Ca(OH)_2 & + & Ca(H\,CO_3)_2 & = & 2Ca\,CO_3 & + & 2H_2O \end{array}$$

Both the carbonate of lime and magnesia are insoluble at 211° F., and nearly so at 60° F., so that the separation of the precipitate becomes mechanically possible.

As will readily be seen, however, care must be taken to add just the quantity of lime required to effect precipitation of the bi-carbonate, as carbonate or calcium hydro-oxide will pass on to the boiler and deposit lime on the boiler parts as evaporation proceeds, and if in any great excess a worse scale will be formed than would have been formed if original matter had been allowed to deposit in the boiler. Moreover, since action of lime water is limited to excess of carbonic acid, free or combined with lime and magnesia as bi-carbonates, no reaction will set in between sulphate of lime and lime water, consequently use of this process is limited to waters rich in bi-carbonates, and may be easily detrimental if applied to waters containing much sulphate of lime, particularly if any excess is added, as then the whole of the essential requirements for the formation of a hard compact scale would be present.

It was originally my intention to show the reaction that would set up between a number of the many compounds on the market, but I find to do this, subject will become unreasonably long. I will then confine myself to a few of the most commonly used substances.

Possibly the chief of these is common hydrated carbonate of soda, or what is commercially known as "sal soda." This compound is largely used for softening water both of temporary and permanent hardness, reactions settling in with both bi-carbonate and sulphate of lime, as shown in equation :

$$\begin{array}{ccccccc} \text{Bi-carbonate of lime (soluble).} & & \text{Carbonate of soda (soluble).} & & \text{Carbonate of lime (insoluble).} & & \text{Bi-carbonate of soda (soluble).} \\ Ca\,(H\,CO_3)_2 & + & Na_2CO_3 & = & Ca\,C\,O_3 & + & 2NaHCO_3 \end{array}$$

In this case the basic carbonate of soda absorbs or combines with the excess of carbonic acid combined with carbonate of lime and soluble bi-carbonate of soda, and insoluble carbonate of lime is formed. (Note, the reaction with the magnesia salts is similar.)

A reaction also sets in between the sulphate of lime present and the carbonate of soda ; thus :

$$\begin{array}{ccccccc} \text{Sulphate of lime.} & & \text{Carbonate of soda.} & & \text{Carbonate of lime.} & & \text{Sulphate of soda.} \\ Ca\,SO_4 & + & Na_2CO_3 & + & CaCO_3 & + & Na_2SO_4 \end{array}$$

Another commonly used and useful reagent is the tribasic phosphate of soda, which is in many cases to be recommended as a good reagent, its chief property being the ease with which the reaction sets in and the entirely unhardenable properties of the precipitate. With sulpphate of lime the reaction is :

$$\begin{array}{ccccccc} \text{Tri-basic phosphate of soda.} & & \text{Sulphate of lime.} & & \text{Phosphate of lime.} & & \text{Sulphate of soda.} \\ 2Na_3PO_4 & + & 3CaSO_4 & = & Ca_3(PO_4)_2 & + & 3Na_2SO_4 \end{array}$$

The chief objection to use of chemical compounds of this type is their property of throwing precipitates down, which, if allowed to accumulate, become very troublesome, and, to overcome this, frequent efforts are being made to introduce compounds that will bring about a chemical change but leave the product soluble in water. A great deal may be said for and against use of compounds of this kind—particularly against.

Many compounds of this nature contain a compound known as "sal ammoniac," a salt known in chemistry as chloride of ammonia, or muriate of ammonia, and having the composition NH_4CL.

The reaction between the lime salts and ammonium chloride is a very distinctive one ; taking, for instance, sulphate of lime, we get:

$$\begin{array}{ccccccc} \text{Sulphate of lime.} & & \text{Sal ammoniac.} & & \text{Chloride of lime.} & & \text{Ammonium sulphate.} \\ Ca\,SO_4 & + & 2NH_4Cl & = & CA\,Cl_2 & + & (NH_4)_2SO_4 \end{array}$$

Both sulphate of ammonia and chloride of lime (note 1) are easily soluble in water, and a high degree of concentration would have to be reached before deposit of solid matter could take place ; but, as I have already pointed out, natural waters containing lime salts, either sulphate or carbonate, nearly always contain magnesia in some form or other, and I may be pardoned for once more referring to the great danger attendant upon the use of sal ammoniac in presence of magnesia. Taking, for instance, magnesia as commonly present as bi-carbonate, a reaction between this salt and sal ammoniac would set up as follows :

$$\begin{array}{ccccccc} \text{Bi-carbonate of magnesia.} & & \text{Sal ammoniac.} & & \text{Magnesium chloride.} & & \text{Bi-carbonate of ammonia.} \\ Mg\,(HCO_3)_2 & + & 2NH_4Cl & = & Mg\,Cl_2 & + & 2NH_4CO_3 \end{array}$$

Magnesium chloride is very unstable, and in presence of heat at once breaks up into oxide of magnesia and hydro-chloric acid. The acid, being volatile, passes off with the steam, and plays havoc with steam pipes and engine valves ; while magnesia salt is in even worse shape than it was originally, since oxide of magnesia is a very fine substance, entirely insoluble in water, and forming a ready bonding agent. Any compound containing even a small percentage of sal ammoniac should be looked upon with suspicion, unless magnesium salts are entirely absent from feed water.

(Concluded in Next Issue.)

Note.—$Ca\,Cl_2$ must not be confounded with the compound usually sold as a disinfectant under the name of chloride of lime, which is a mixture of chloride and hypochlorite of lime.

Bell Telephone Company's Building, Notre Dame Street, Montreal.

AUTHORS OF C. E. A. PAPERS.

Below will be found some particulars of the gentlemen who have prepared papers for the forthcoming contion in Montreal of the Canadian Electrical Association:

Mr. James Milne,

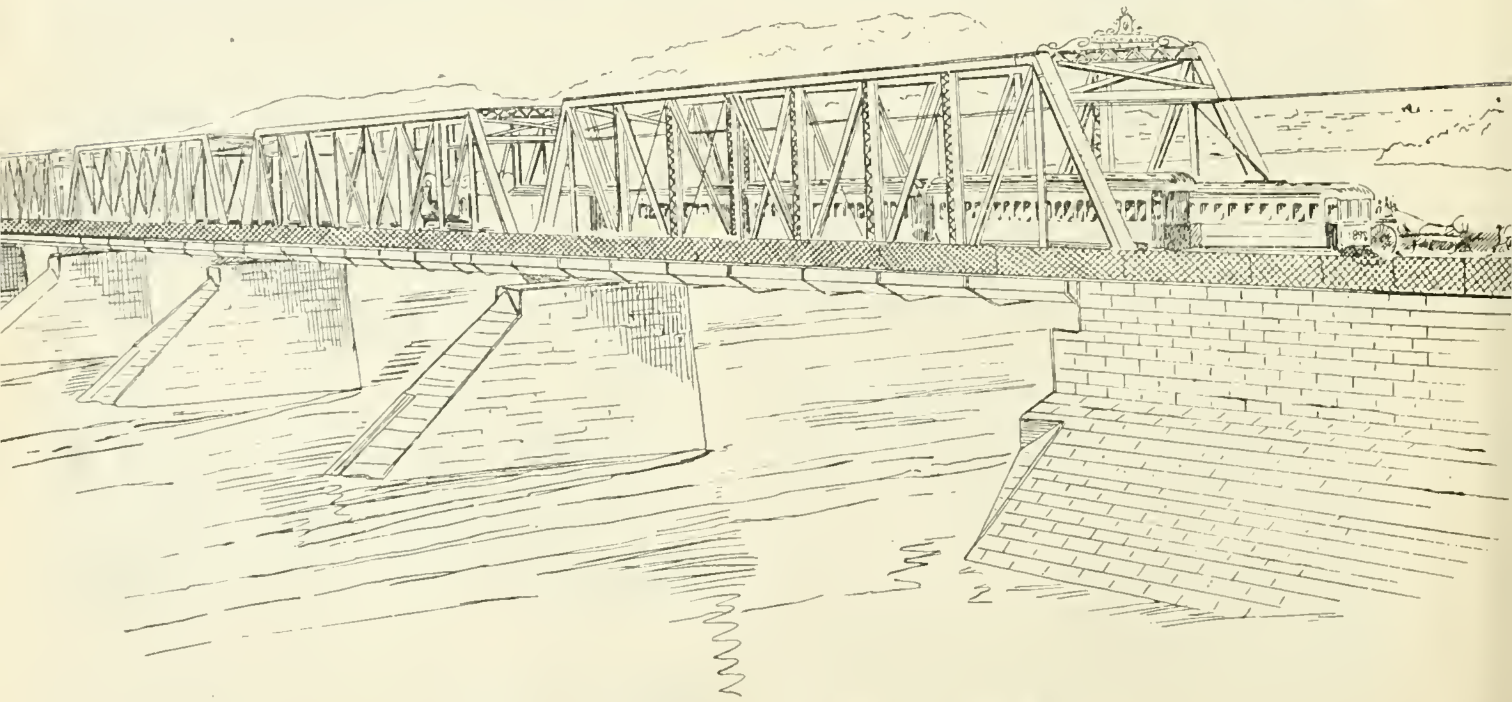
Author of the paper on "Economies in the Boiler Room," was born in Aberdeen, Scotland, in the year 1865. He served a five years' apprenticeship in engineering at Mugiemoss Paper Works, Aberdeen, Scotland, attended Gordon's college, Aberdeen, and secured from the Science and Art Department, South Kensington, London, first-class diplomas in machine construction and drawing, applied mechanics, steam and the steam engine and other branches. Twelve years ago he came to Canada and was engaged by M. D. Barr & Co. and the Edison General Electric Company, afterwards becoming a partner in the Keegans-Milne Company, electrical engineers and contractors, Montreal. Withdrawing from this firm he was appointed general superintendent of the Toronto Incandescent Light Company, and while thus engaged lectured on "Electricity" and "Steam and the Steam Engine" at the Toronto Technical School. A few months ago Mr. Milne became associated with the Weeks-Eldred Company, now the General Engineering Company of Ontario, of which he is now managing director.

Mr. Fred. A. Bowman, M.A., B.E.

Mr. Bowman, author of the paper on "The Importance of Proper Methods of Illumination," was born at Windsor, N. S., and graduated in arts and mining engineering at King's College. He took the expert course at the Thomson-Houston Works at Lynn, Mass., and held a position with the New York office of the same company. For one year he was in the employ of the Royal Electric Company at Montreal, and since 1892 has occupied the position of superintendent of the New Glasgow Electric Light Co., of New Glasgow, N. S. Besides being associated with the Canadian Electrical Association, he is a member of the American Institute of Electrical Engineers, and president of the recently organized Maritime Electrical Association. His portrait appeared in our May issue.

Mr. A. A. Wright

is a Canadian by birth, having been born in the county of Leeds on the 6th of June, 1848. He received his primary education at the Farmersville High School. From there he went to the Toronto Normal, where he obtained his first-class certificate. Being anxious to acquire a thorough knowledge of the French language he proceeded to Berthier-en-Haut, in the Province of Quebec, where he devoted his time entirely to the perfecting of his knowledge of that language. Leaving Quebec in 1870 he returned to his native province of Ontario and engaged in mercantile business



New Victoria Bridge, Now in Course of Construction, Montreal.

in Renfrew, where he has remained, and is now the head of the firm of A. A. Wright & Co. In 1886 his firm first entered the field of electric lighting, purchasing two Ball arc machines, which they ran in connection with their grain elevator. Later on they added a T. H. alternating plant, and have continued in the electrical business ever since. Mr. Wright was one of the originators of the Canadian Electrical Association. He was chosen as one of its first directors, and still continues to take no small interest in the working of the society. He is an ardent politician, but has successfully withstood all attempts to allow his name to be put forward for political honors, although frequently urged to do so.

Dr. J. K. Johnstone.

Dr. Johnstone was born at Brantford, Ont., in October, 1849. He graduated in medicine in the year 1870, and practiced for about twelve years, when he received an appointment to the Inland Revenue Department as Inspector of Gas. Upon the adoption by the Dominion Government of an act for the inspection of electric light, he was appointed inspector for the inland revenue districts of Toronto, Guelph and Owen Sound, in addition to his former duties, with head office in Toronto.

Mr. Wm. T. Bonner,

who contributes two papers for the coming convention of the Canadian Electrical Association, and whose portrait appears in the group of the local committee on another page, is a native of Ohio. His early education was commenced in a private school in Chillicothe, where he remained until finishing in the high school, when he took a practical engineering course in field work under Wm. E. Strong, an eminent civil engineer engaged in railroad construction and river improvement for the United States government. About this time he contracted the West Point fever, and through personal application at Washington, received from President Hayes promise of appointment. Some trivial incident occurred, however, which caused him to adopt a commercial course, filling two positions between 1878 and 1883 with book and stationary firms in Chillicothe and Toledo.

In 1883 Mr. Bonner married Miss Baker, of Toledo, and returned to Chillicothe to manage the grain and feed business of his father, who died early in 1884. A few months later he was elected secretary and manager of the Great Western Carbon Co., organized by a syndicate of Toledo capitalists to build and operate large works in Omaha for the manufacture of ammonia sulphate and bone charcoal for refining sugar. Although the feed mill in Chillicothe offered some opportunity for practice in mechanical engineering, it was not until the carbon works were being built that Mr. Bonner's natural tastes were given full scope, and he realized the opportunities before him. Although absolutely without experience and entirely ignorant of the character or process of manufacture of the product to be turned out, the executive and technical management of the carbon business was entrusted to him, and within a year he brought the works to a state of perfection highly satisfactory to his company—certainly a creditable achievement for a youth of twenty-four. In 1888 the business was wound up owing to failure of supply of raw material, and he then commenced business for himself as contracting mechanical engineer, making a specialty of designing and installing steam power plants. In this he was fairly successful until the repeated failure of crops in the west burst the bubble of inflated values in Omaha, Kansas City and other places in 1890.

Mr. Bonner then moved to Chicago and accepted a situation as Chicago salesmanager for Fraser & Chalmers. This position was soon enlarged to include cable railway and steam power work generally. During the summer of 1891 he engineered the deal which secured for Fraser & Chalmers the complete contract for the great Masonic temple, up to that time the largest known steam power installation for commercial buildings. Owing to his success in this connection he was afterwards given charge of many important negotiations for power installation all over the continent, including the great Broadway cable plants in New York city in 1891, requiring over 4,000 tons of boilers, engines, cable winding machinery and connections, and costing more than half a million dollars. Mr. Bonner still regards with pardonable pride the flattering comments of his principals in their letters to him while engaged on this negotiation in New York. After the close of the World's Fair he went to New York as general eastern agent for the Butman Company, of Chicago, builders of a new type of vertical boiler, continuing there, with the exception of a short engagement in Chicago late in 1894, until January, 1895, when he came to Montreal as general Canadian agent for the Babcock & Wilcox Company of New York.

Although Canada had been included as a part of the territory ceded to the English company at the time of its organization in 1880, the New York company continued to operate it up to July, 1896, when Babcock & Wilcox, Limited, assumed active charge and Mr. Bonner accepted the Cincinnati office as his choice of the United States districts offered him by the New York company. Within a few months, however, he was called to London to consult with the English company regarding Canadian business, with the result that he returned to Montreal in October, 1897, as manager for the entire Dominion of Canada, which position he now holds.

Bonaventure Station, Montreal.

Mr. Bonner is very enthusiastic about his chosen profession, and makes it an invariable rule to study the principle and plan of any important engineering work or power installation wherever he goes. During the past fifteen years he has visited every important place in Canada and the United States east of the Rocky mountains, and the information gained from personal observation of engineering methods here and also in England, Ireland, Scotland and France, places him in a very enviable position as a consulting engineer. Naturally of an inventive turn of mind and quick to devise methods for overcoming difficult engineering problems, his contracts are carried out with satisfaction alike to his company and their customers. The Babcock & Wilcox offices in Montreal also reflect his taste and ingenuity, being generally regarded by well posted authorities as unequalled for convenience and effective display.

Although a member of several social and athletic clubs, Mr. Bonner is not in any sense a club man, preferring the more profitable pleasure of technical organizations. A member of the American Society of Mechanical Engineers since 1892, Mr. Bonner, on coming to Canada, soon became interested in the Canadian Electrical Association and the Canadian Mining Institute, being reelected in March last a member of the executive council of the Quebec division.

As early as 1876 he contributed to the local publications notes on his observations at the Centennial and other subjects. His paper on ancient Pompeiian boilers read before the New York meeting of the American Society of Mechanical Engineers in 1896 was very extensively copied and commented upon by the technical and news papers all over the United States, and also by London Engineering and many other journals in nearly every foreign country.

MR. M. W. HOPKINS.

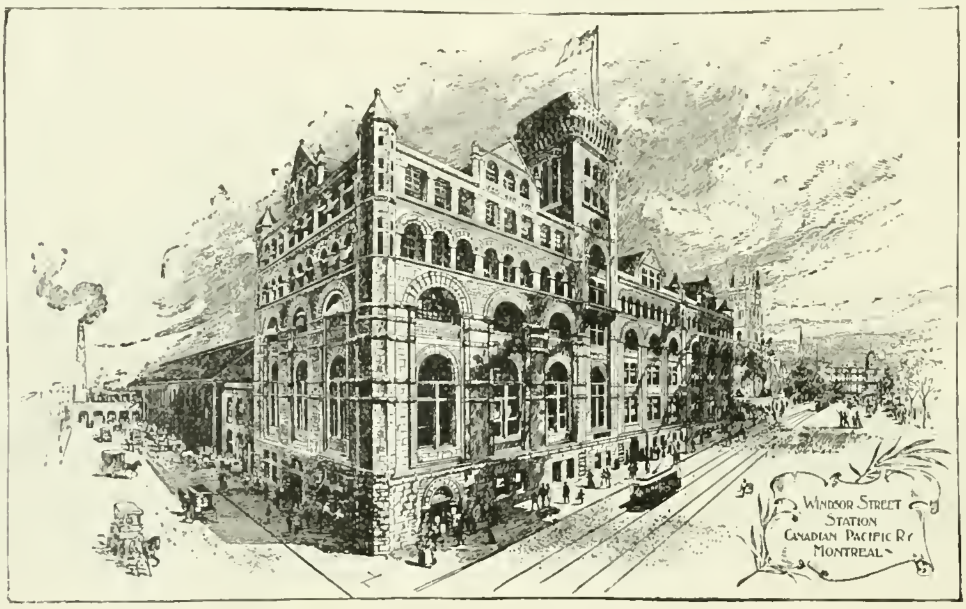
Mr. M. W. Hopkins, B.Sc., C.E., author of the paper on "The Electric Current in the Rainy River Gold Mines," was connected with the construction of the Hamilton, Grimsby and Beamsville Electric Railway. Recently he has been engaged in civil engineering in the gold fields of Northwestern Ontario.

MR. L. DEWITT MAGIE.

MR. L. DeWitt Magie was born in Northern Pennsylvania about 32 years ago. He became connected with the Stanley Electrical Mfg. Co., of Pittsfield, Mass., at its inception in 1890, remaining with them until June, 1895, when he received the appointment of chief electrical engineer of the Royal Electric Company, Montreal, with whom he has been engaged since that time. Mr. Magie gained considerable prominence in Canadian electrical circles in connection with the electrical work on the North Shore Power Company's plant at Batiscan Chute, Que., carrying power to Three Rivers, a distance of 16 miles, and also in the reorganizing of the Montmorency Power Company's work at Montmorency Falls, Que., transmitting power to Quebec city, a distance of 10 miles. He is also chief of the Chambly Mfg. Co.'s plant, which will transmit power from Chambly Rapids to Montreal. This plant is the largest of its kind in Canada, conveying electrically 25,000 h.p. a distance of 14 miles.

THE ELECTRIC LIGHTING FRANCHISE AT OTTAWA.

THE following review of the steps that have been taken in connection with the application of the Deschenes Electric Company for permission to supply light and power within the city of Ottawa is furnished by a correspondent :



The Ottawa Electric Company, which is a combination of the three electric lighting companies formerly existing in the city of Ottawa, namely, the Chaudiere Electric Light & Power Co., the Standard Electric Co. of Ottawa, Limited, and the Ottawa Electric Light Co., have had a busy time lately fighting off opposition.

The Deschenes Electric Company, incorporated by letters patent and promoted by the principle owners of the Hull Electric Company, applied to the Dominion government and obtained permission to lay cables across the Ottawa river opposite the city, and to bury such cables on the government reserve along the banks of the Rideau canal to a point opposite the Canada Atlantic central station, from where they could distribute current to the city. The cables having been successfully laid, they were connected to the Russell Theatre, which they could light without using any of the city streets. Later on they filed an application with the City Council asking for permission to supply light and power to the citizens of Ottawa. This application was referred to a special committee, who asked both the Ottawa Electric Company and the Deschenes Company to make proposals to the city as to what rates they were disposed to accept, etc. The Deschenes Company asked a rate of one cent per ampere hour, with cash discount of 40%, while the Ottawa Company offered a similar rate, with 33⅓% for prompt payment. On account of the large number of customers who would get immediate benefit of the discount, and the fact that the Deschenes Company had not yet any business in the city, it was urged by the Ottawa Company that their offer was as advantageous as that of the Deschenes Company. They were later asked to make their discount 40%, which they agreed to do, and which they immediately did, announcing in the city papers that this discount would be granted from that date.

When the question came up before the City Council, the application of the Deschenes Company (which, by the way, did not offer to pay the city anything, although the company is not a local one and were paying nothing to the city in the way of taxes, etc.) was refused by a vote of 14 to 10. Notice of reconsideration was immediately given by one of the aldermen.

During these events a gentleman connected with the Deschenes Company made statements in the public press charging certain aldermen with getting their lights from the Ottawa Electric Company free of charge. This was immediately taken up by the Ottawa Company, who appointed the president of the Board of Trade as referee, and asked him to appoint certified accountants to go through the books of the company. This he did, and published a report completely exonerating the aldermen from the charge, and showing it to be absolutely false. In the meantime, a public meeting had been called at the city hall to consider the question of these charges, at which meeting the accuser of the aldermen was to substantiate his charges, or failing to do so was to give $100 to the charities of Ottawa. The meeting was largely attended and proved a boomerang to those who had called it. Not only were the charges dropped in the most ignominious manner, but the meeting proved itself in favor of municipal ownership, and asked that no other company be allowed to do business in the city, and thus complicate matters for a transfer to the city.

At a later meeting of the City Council the aldermen refused to re-consider the question. A motion to rescind at the end of the meeting was also voted down. The motion adopted by the Council gave the Ottawa Company a monopoly of electric lighting in Ottawa for seven years, the unexpired portion of their contract for lighting the city streets, and the company agreed to sell out to the city by arbitration at any time the city might wish to acquire their plant and business. The legality of this was attacked on the ground that the Council could not give exclusive privileges ; this was confirmed by the City Solicitor's opinion in writing. A motion was then introduced providing that the city give the Ottawa Electric Company such exclusive privileges for seven years subject to the company obtaining the necessary legislation to enable the city to make with the company a contract to that effect. This would have settled the case between the companies and the city, but it was side-tracked by an amendment referring the question back to the committee in order that they might ascertain from the Ottawa Company on what terms it would sell out to the city. The matter now rests there, and it would be interesting to know what the next move will be.

The Ottawa Electric Company, who spend $100,000 per year in the city, and pay several thousand dollars in taxes, and whose employees all reside in the city of Ottawa, felt that they could not allow a company whose plant and business was all outside to come into the city, and, without paying anything for the privilege, cut rates and take a part of their business from them, without making strenuous efforts to prevent it. In this they were supported by a large portion of the citizens, who felt that the home company should be given the preference, especially when they were willing to make their rates as low as any that had been offered, and it was also the general opinion that it would be better to have only one company to deal with should the city ever wish to acquire a plant.

It is not unlikely that a plebiscite will be submitted to the electors asking if they are favorable to the city owning and operating an electric plant, not only for street lighting of the city, but also for distribution to the citizens generally.

In the Council fourteen of the aldermen are stated to have supported the contentions of the Ottawa Company. There were some among the ten who opposed it who fought bitterly against the company. One would think from their treatment of the matter that the company had been a public nuisance rather than the means of introducing electricity into almost every home in the city at a time when it was difficult to get any capitalist to invest his money in electrical enterprise. Now that the company has shown that the business can be made to pay, there are many ready and anxious to spoil their business in order to get a small slice themselves.

The Royal Electric Company is installing an arc plant for the Soulanges Canal.

CANADIAN PACIFIC RAILWAY COMPANY'S LONG COPPER WIRE.

Owing to the Yukon excitement, and the greater prosperity now prevailing throughout Canada, the telegraph business between the far west and eastern Canada has so largely increased as to necessitate the erection of additional wires by the Canadian Pacific Railway Company's telegraph department. In addition to over 1,000 miles of iron wire put up on different sections this year, the management decided on stringing a copper wire weighing 300 pounds per mile from Montreal to Vancouver, to be used for Pacific coast business. Montreal to Vancover being too great a distance for the practical working daily of a through connection by means of an iron wire, all transcontinental telegrams are at present received and transmitted at Winnipeg, two iron wires of 580 pounds per mile being used. This entails additional expense for salaries, and, of course, a certain amount of delay. Copper being about six times better as an electric conductor than iron, the new wire will bring Vancouver nearer to Montreal, electrically, than now Winnipeg is.

The circuit will be worked duplex, i.e., telegrams passing in opposite directions simultaneously. Automatic repeaters will be placed at Fort William, Ont., and Swift Current, N.W.T., thus dividing the line into three, approximately, equal sections. It is quite likely that during part of the year repeaters will only be required at Winnipeg. The copper wire will be reserved for transcontinental business, and the present two heavy iron wires will be used for business with Winnipeg and the Northwest and any overflow from the copper wire.

Should the overland business increase beyond a certain point, the copper wire will be quadruplexed, i.e., two telegrams sent each way, or four in all, at the same time. When completed this will be the longest land line circuit worked daily in the world.

The wire is being drawn by the Dominion Wire Manufacturing Co., at Lachine, from Calumet and Hecla copper. Tests are made daily from every tenth bundle at McGill college by Graham Drinkwater, under the supervision of Prof. Bovey, L.L.D., C.E. The wire is required to stand a breaking strain of 960 pounds, with an elongation of one per cent ; 30 twists in a six inch length ; to be wound in six close turns around wire of its own diameter, and untwisted without breaking ; weigh between 295.6 and 304.3 pounds per mile ; diameter between .136 and .138 of an inch ; and a minimum conductivity of 96 per cent. of pure copper. Should any sample not pass the tests, each remaining bundle in the lot of 10 is tested and all not passing are rejected. The approved bundles must have an inside diameter of 24 inches, and weigh between 150 and 220 pounds without splice or brace, either in the original rod or the completed wire. Mr. Drinkwater tags each bundle and looks after the shipments. The tie wires are soft copper of the same diameter as the line wire, the manner of tying being one designed by Mr. Townsley. The joints in construction are made with what is known as the McIntyre sleeve with the ends soldered, it having been found that without the solder as made in the United States the joint broke at about 500 pounds strain. By soldering the breaking strain is increased to 900 pounds.

It was intended to use white porcelain insulators, and 120,000 were ordered from Europe ; but on account of delay in shipping the work was commenced and glass insulators used on the section from Montreal to Winnipeg. They are manufactured by the Diamond Glass Co., at Montreal. From Winnipeg west, the porcelain insulators will be used, and probably the glass east of Winnipeg will be replaced with porcelain later on. The insulators will weigh 75 tons.

Although the distance, via new short line to Ottawa, is only 2,897 miles, 3,000 miles of wire is required, equal to 450 tons or 23 car-loads. To make the joints, nearly two miles of wire is used, and the necessary slack between poles takes up some six miles more. A small supply must be left with each lineman for any repairs ; this will eat up about 25 miles more. The tie wires use up six and a quarter tons of copper.

Work was commenced on April 7th by one gang, and as soon as sufficient wire could be supplied other gangs were started out, until there were seven gangs, consisting of 150 men, employed. It was intended to have two more gangs on the work ; but on account of considerable reconstruction of the pole line west of Winnipeg, now going forward, it was thought best not to string the copper until after this work was finished, so as to handle it as little as possible.

The section from Montreal to Winnipeg will be completed during the latter part of June, and will be put in use at once. The whole line is expected to be finished by the first of August, in time to accommodate the heavy fall business.

W. J. Camp, electrician for the department, has supervision over the whole work, which passes over three divisions. The first one from Montreal to Fort William, Ont., 990 miles, is being constructed by four gangs under Jos. Townsley, Superintendent of Construction, eastern division, assisted by J. F. Richardson, Assistant Electrician.

The second stretches from Fort William, Ont., to Donald, B. C., 1450 miles. On this section there are three gangs on the wire and two on pole work, under B. S. Jenkins, Superintendent Telegraph, western division, assisted by S. Edwards, inspector.

The last section is from Donald to Vancouver, 458 miles, J. Wilson, Superintendent Telegraph, Pacific division, assisted by E. H. Grindrod, inspector, will have two gangs on this portion. They are now on reconstruction and will start work on the copper about the middle of June.

MR. CHAS. R. HOSMER.

Mr. Hosmer, who is at the head of the Canadian Pacific Railway Co.'s telegraph system of Canada, was born of American parents in the small village of Coteau Landing, Que., (about forty miles from Montreal) in November, 1851. He started learning telegraphy at the Grand Trunk railway station at that village when a lad of thirteen, and took charge of his first telegraph office in August, 1866, since which time he has been constantly employed in the telegraph business in one capacity or another. He taught telegraphy at Beauharnois, Maskinonge and Ratiscan, in the province of Quebec, during the year 1868. From Coteau Landing he went to Kingston, Ont., in the service of the Montreal Telegraph Company, and was made manager of the Dominion Telegraph Company at that place in 1870. With the same company he worked in Buffalo in 1871, and was transferred to Montreal as superintendent of the Dominion Telegraph Company in 1873, at the age of 22. He remained in the service of the Dominion Telegraph Company until it was amalgamated with the Great North-Western Telegraph Company, when he organized the Canada Mutual Telegraph Company (in 1881), which was the Canadian connection of the Mutual

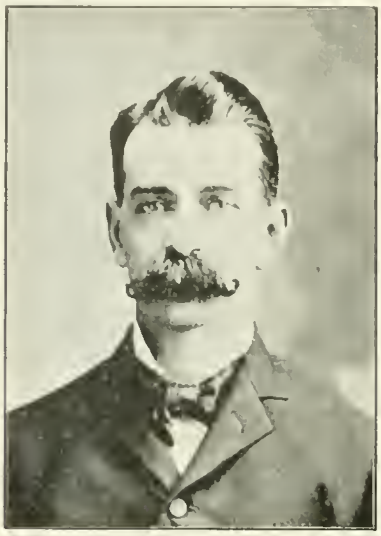
Mr. Chas. R. Hosmer.

Union Telegraph Co. He was president and general manager of this company until he went into the service of the Canadian Pacific railway in 1886.

Mr. Hosmer is one of the vice-presidents of the Commercial Cable Company, and is also a director of the Postal Telegraph Company in New York, as well as of the Direct West Indies Cable Company.

MR. W. J. CAMP.

Mr. Camp, electrician of the Canadian Pacific Railway Company's telegraph department, was born April 2nd, 1855, at Oakville, Ont. He entered the service of the Dominion Telegraph Company at Prescott, Ont., in 1874, and in a few months was in charge of the wire testing in that district; the following spring he was transferred to Montreal as book-keeper. In 1876 he was promoted to be manager of the office at Watertown, N. Y., but a few months later left the service and worked on different points on the New York Central railroad, Troy and Boston railroad, and for the Western Union Telegraph Co., at Albany, N. Y., leaving the latter place to re-enter the service of the Dominion Telegraph Company at Montreal, where he was appointed night chief. In January, 1878, he became train despatcher for the Q. M. O. & O. R. R., but on the government seizing that road he returned to the night chiefship of the Dominion Telegraph Co., later on being advanced to assistant day chief. When the amalgamation of the telegraph companies took place he was retained by the Great North-Western Telegraph Company. In 1884 he was appointed superintendent of the Holmes Electric Burglar Alarm Company at Montreal, from which he resigned to accept his present position.



Mr. W. J. Carp.

Mr. Joseph Townsley.

MR. JOSEPH TOWNSLEY.

Mr. Townsley was born at Rockfield, Ont., on the 24th day of January, 1842. On the 1st day of May, 1867, he entered the employ of the Montreal Telegraph Company on line repairs and construction, and only severed his connection with the old company on May 1st, 1882, to accept his present position of superintendent of construction and repairs on the eastern division of the Canadian Pacific Railway Company's telegraph.

MR. B. O. JENKINS.

Born April 8th, 1859, at Richmond Hill, County York, Ont., Mr. Jenkins entered the telegraph service at fourteen years of age at Madoc, Ont. After several years service with the Montreal and Dominion telegraph companies at different points, he went to Manitoba in 1881 for the Canadian Pacific Railway Co., and was appointed superintendent of telegraphs on the western division of the system in 1883.

Mr. B. O. Jenkins.

MR. JAMES WILSON.

Mr. Wilson was born in Elora, Ont., 1856. He first worked in the Montreal Telegraph Company's office at his native town until August, 1870. In 1872 he joined the Dominion Telegraph Company's staff in Toronto, and was transferred in 1876 to the direct United States cable station at Tor Bay, N. S. In 1876 he was inspector and paymaster of construction, and in 1879 superintendent of construction for the Dominion Telegraph Company in the maritime provinces. In May, 1880, he was appointed district superintendent in British Columbia of the Dominion government telegraphs, which position he held until the system was purchased by the Canadian Pacific Railway Company, October 1st, 1886, when he was appointed superintendent of the Pacific division of the Canadian Pacific Railway's telegraph system.

Mr. James Wilson.

MR. JAMES KENT.

Mr Kent, Superintendent of the Canadian Pacific Telegraphs, Montreal, Quebec, was born in Montreal on January 15th 1854. He entered the service of the

Montreal Telegraph Company as messenger, shortly after leaving school in 1868. He was promoted to the operating room as check boy, and after a short time became an operator. After working as such for five years he was appointed night chief, and subsequently day wire chief for the same company, which position he held until 1886, when he resigned to accept the position of chief operator of the Canadian Pacific Railway Telegraphs at Montreal, which opened for business that year. In 1890 he was promoted to the superintendency of the eastern division of the same system, which position he still holds.

Mr. James Kent.

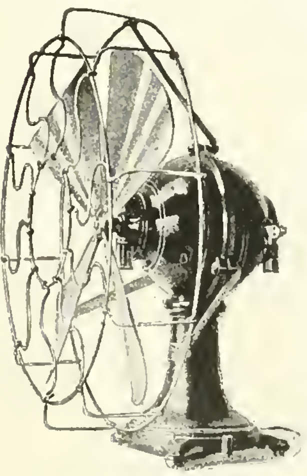
AN UP-TO-DATE SUPPLY HOUSE.

THE establishment of R. E. T. Pringle, 216 St. James street, Montreal, is now well and favorably known throughout Canada as one of the leading supply houses. Previous to 1898 Mr. Pringle had only a small office, from which he transacted a small but growing business, confining his efforts, however, almost exclusively to the sale of Packard lamps and transformers and Toronto motors and generators; but in January of last year, realizing the large field and increasing demand for all lines of electrical goods, he opened his present establishment, where, notwithstanding keen competition, he has, by sound business principles and straightforward dealing, built up what is generally conceded to be one of the most up-to-date supply houses in Canada. Intending visitors to the Electrical Association Convention should not fail to call on Mr. Pringle, who is a member of the local committee, and whose genial countenance appears on another page of this issue.

FAN MOTORS.

SOME means of maintaining a circulation of air to lessen the oppressive heat of summer have been employed by all nations for many centuries. A marked difference, however, exists between ancient and modern methods, and the development of the electric fan motor is one of the triumphs of nineteenth century civilization.

Now that the fan motor has passed through the experimental stage, and is a commercial success, both electrically and mechanically, it has become an important factor wherever the electric system is in use, in making more endurable the heat of the summer months.



C. G. E. Fan Motor.

For the season of 1898, the Canadian General Electric Company, Limited, present a splendid line of fans for both direct and alternating current circuits. These machines are designed with great care, special attention being paid to thoroughly tested construction. The best of material is used, and the workmanship is first-class in every particular, thus ensuring both durability and noiseless operation. They are artistic and substantial in appearance, besides embodying every valuable improvement suggested by long, practical experience. The various parts are as well proportioned as in larger machines, and no fear of excessive wear or heating need occur where the motors are operated continuously. Attention is called in our advertising columns to the specifications of the various types of fan motors handled by the Canadian General Electric Company.

The exclusive field covered by the CANADIAN ELECTRICAL NEWS renders it a valuable advertising medium.

MR. WILLIAM SUTTON.

WE present herewith a portrait of Mr. Wm. Sutton, a charter member and past vice-president of the Canadian Association of Stationary Engineers, and president of the Wm. Sutton Compound Co., of Toronto, Limited. Mr. Sutton is the inventor of the Sutton boiler compound, Sutton steam blower and vaporizer, and the Sutton tile machine. He was born in 1834, in Lincolnshire, England, and received his engineering training at Messrs. Tuckford's Engine and Machine Works in the city of Boston, Lincolnshire. After a few years he was appointed assistant-engineer at Billinghay Dales pumping station, and while thus engaged began first experiments in connection with boiler scale and its removal by vegetation. While pumping the water off the moors into the sea, a marked improvement was noticeable at different periods of the year. He continued his study along these lines until a few years ago, when he completed his task and placed upon the market the now famous Sutton boiler compound, which is said to be meeting with success wherever used.

Mr. Sutton came to Canada forty-two years ago, when a young man, and since that time has held responsible positions, being chief engineer of the Orangeville waterworks, travelling engineer for the Slate Line and Sullivan Railroad, and engineer for the Pure Gold Mfg. Co., of Toronto. It was while in the employ of the last-named company that the final tests of his study and experiments were concluded. By the advice and persuasion of his friends, and realizing the field for a first-class article for the removal of boiler scale, he decided to manufacture the compound for the benefit of steam users. Mr. Sutton claims for his invention that it contains no acids, caustic soda, or zinc, and that those who have given it a trial acknowledge it a superior compound, its use resulting in no injury to the boiler, valve seats or packing. It is therefore used extensively by breweries, bakeries, dye works, steam laundries, etc.

Owing to increased business, it was soon found desirable to form a company to undertake the manufacture and sale of the compound. This is known as the Wm. Sutton Compound Company, Limited, being composed of some of the leading manufacturers in the city, the office being at 206 Queen street east, Toronto. Since placing the compound on the market, the sales have increased so rapidly as to necessitate several additions to plant and stock. Mr. Sutton naturally feels a justifiable pride that, after years of study and experiment, carried on under rather unfavorable circumstances, satisfactory results have finally been accomplished. Upon request the company will gladly furnish a sample of the compound to steam users.

Mr. William Sutton.

PUBLICATIONS.

E. L. Powers, of Monadnock Block, Chicago, issues quarterly the American Electrical Directory and Buyer's Manual, combining what is claimed to be a complete list of electric lighting central stations in the United States, Canada and Mexico, with details and other valuable information. It is issued in January, April, July and October, the subscription price being $4 annually.

We have been favored by the Canadian publishers, The Copp Clark Co., Limited, of Toronto, with a copy of a Pocket Hand Book for Mechanical Engineers recently compiled by Mr. David Allan Low (Whitworth Scholar), M. I. Mech. E., Professor of Engineering East London Technical College. The book, which is well printed and bound in cloth, is 4 × 6 inches in size, and comprises 750 pages, with upwards of 1,000 illustrations. The author claims to have spared no pains to verify the correctness of the tables and calculations embodied in this book so as to make it thoroughly up-to-date. The price is not given, but may be obtained by persons interested on application to the Canadian publishers as above.

G. B. Burland, of Montreal, has installed a Kingsley water tube steam boiler plant in the Union Card and Paper Company's new works. This is the second order that Mr. Burland has given for Kingsley boilers after using them for four years. They were installed by E. A. Wallberg, of Montreal.

SPARKS.

Steps have been taken at Truro, N. S., to improve the quality of electric light wiring done in buildings.

The Toronto Railway Company have ordered from the Canadian General Electric Company twenty additional C.G.E. 1000 motors.

Charles Baillairge, C.E., of Quebec, at the request of a Belgian firm, has made a test of the water power of a river about twenty miles below Malbaie, Que.

The Jenckes Machine Co., of Sherbrooke, Que., shipped on the 5th May one of their complete 10 stamp mills to the Cariboo Mining, Milling & Smelting Co., Fairview, B.C.

The Great Northwestern Telegraph Company have completed an extension of their line into British Columbia. Offices will shortly be opened at Vancouver and other important points in the province.

Mr. R. Prefontaine, of St. Agathe des Monts, Que., has placed an order with the Canadian General Electric Co. for one of their thousand light single phase standard ironclad armature type of alternating current generators.

Messrs. Geo. M. Webster & Co., of Quebec, coal handlers, are improving their facilities for unloading steamers, and for this purpose have placed an order with the Jenckes Machine Co., of Sherbrooke, Que., for four of their double cylinder rapid coal hoisting engines, with boilers.

The Finance Committee has made a recommendation to the City Council that steps be taken to acquire the street railway system, and that the committee be authorized to obtain such information as will enable it to recommend to the council an offer for the company's property.

The Pembroke Navigation Company has placed an order with the Canadian General Electric Company for equipping their steamer Victoria with a complete electric lighting plant, which will include a six kilowatt Edison type dynamo, a vertical automatic engine, and a search lamp of 4000 candle power.

The Cornwall Electric Street Railway Company, Limited, have ordered from the Canadian General Electric Company four C.G.E. 1200 motors, to be used in the equipment of another freight locomotive which they have been obliged to put on their road to supply the increased demands on them for freight service.

The Smuggler Gold Mining Co., with headquarters at Toronto, have decided to put a 20 stamp mill on their property at Fairview, B. C., this summer, and an order for the same has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for Corliss engine, 20 stamps, vanners, and four miles of Aerial tramway.

The Canadian Copper Co., of Copper Cliff, Ont., are fitting a new shaft, and have placed an order with the Jenckes Machine Co., of Sherbrooke, for two 100 h.p. special steel boilers, one 12 x 15 double cylinder double drum winding engine, three large steam pumps and rock breaker, and necessary gear for operating same.

The Toronto Electric Light Co. and G.N.W. and C.P.R. Telegraph Companies are considering the question of putting the electric wires underground on Yonge street, between Front and King streets. The city engineer estimates that a conduit containing twelve ducts, each capable of carrying 200 wires, would cost $29,000.

The North Shore Electric Railway Co. has been granted a Dominion charter, the promoters being William Owens, of Westmount, R. Prefointaine and A. J. Corriveau, of Montreal, and others. It is intended to build a railway from Three Rivers along the north shore of the St. Lawrence river, and to use the power generated at Shawenegan Falls.

The city engineer of London, Ont., has submitted an estimate for the construction and operation of a civic electric lighting plant, showing the cost to be 25.06 cents per light for 350, as against 25 cents per light for 298 lights 2,000 candle power, as at present paid, per contract. The estimate for the proposed arc plant of 350 lights is $80,236.50.

The Bell Asbestos Co., of Thetford Mines, Que., are changing their system of operating their mine hoist, and for this purpose have placed an order with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 100 h.p. steel tubular boilers, and have also purchased from the same company one of their small locomotives, for shifting cars in pits.

In the Hull Superior Court recently judgment was rendered by Judge Lavergne in the case of the Bytown and Aylmer Turnpike Company against the Hull Electric Company. The judgment recited that defendant against the will of the plaintiff forcibly took possession of certain portions of the Aylmer road and built an electric railway along and across the highway. The judge ordered defendants to forthwith remove all its tracks, poles, wires and other apparatus from the portions of the road, and in default 15 days from the service on the defendant of the present judgment plaintiff is authorized to do so at the expense and risk of the defendant, and the defendant is enjonied to refrain for the future from using the highway, and is condemned to pay plaintiff $1,056 with costs.

The Recorder at Montreal has given judgment against the Montreal Street Railway Company for the nominal sum of $25 and costs for refusing to build and operate their line up Cote des Neiges Hill, as agreed by them in their contract with the city, within a certain space of time that expired on the 1st of May, 1897. The company argued that the road would be too dangerous, but the city obtained evidence from experts to prove that the new street car line in Quebec is built with much shorter curves, much steeper hills, and much shorter declines and inclines than would mark the line in question. The Recorder said: The preponderance of testimony shows that if there is to be any danger attached to the line, that danger can only be caused by negligence, ignorance or imprudence on the part of the company, its engineers or other employees, and to this all institutions of a similar nature are liable. He regretted exceedingly to be compelled to find the company guilty, because, as a rule, it had fulfilled its duties towards the city well; but it had neglected its agreement with the city in this instance, and without being able to prove that there was really anything to prevent its carrying out its obligations.

As the first step towards the inauguration of a system of radial railways for Toronto, a committee of the Board of Works had a conference recently with the management of the Metropolitan street railway. It was suggested that the Toronto Street Railway Company give running powers over the Church street route, which could be used as a trunk line for all the radial roads. One difficulty in the way, however, is that the statute provides that the standard width of all radial railways shall be 4 feet 8¾ inches, while the Metropolitan and Toronto railway tracks are 4 feet 10¼ inches apart. The committee decided to have an interview with the manager of the Toronto street railway and endeavor to formulate a plan which would be acceptable both to the street railway and suburban companies.

MOONLIGHT SCHEDULE FOR JULY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	No Light.	No Light.	.....
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	P.M. 8.00	P.M. 10.30	2.30
6....	″ 8.00	″ 10.30	2.30
7....	″ 8.00	″ 11.00	3.00
8....	″ 8.00	″ 11.30	3.30
9....	″ 8.00	A.M. 12.10	4.10
10....	″ 8.00	″ 12.40	4.40
11....	″ 8.00	″ 1.00	5.00
12....	″ 8.00	″ 1.20	5.20
13....	″ 8.00	″ 2.00	6.00
14....	″ 8.00	″ 2.40	6.40
15....	″ 8.00	″ 3.40	7.40
16....	″ 8.00	″ 3.40	7.40
17 ...	″ 8.00	″ 3.40	7.40
18....	″ 8.00	″ 3.40	7.40
19....	″ 8.00	″ 3.40	7.40
20....	″ 8.00	″ 3.40	7.40
21....	″ 8.00	″ 3.40	7.40
22....	″ 8.00	″ 3.50	7.50
23....	″ 8.00	″ 3.50	7.50
24 ...	″ 8.50	″ 3.50	7.00
25 ...	″ 9.30	″ 4.00	6.30
26....	″ 9.50	″ 4.00	6.10
27....	″ 10.40	″ 4.00	5.20
28....	″ 11.00	″ 4.00	5.00
29....	″ 11.30	″ 4.00	4.30
30....	....	....	.....
31....	A.M. 12.40	″ 4.00	3.20
		Total......	150.30

IMPROVED STORAGE BATTERY EQUIPMENT.

Under the supervision of Mr. A. B. Smith, superintendent of construction, the Great Northwestern Telegraph Company have just made an important change in their battery system at the London office, by the installation of a very complete storage battery equipment, consisting of 260 chloride accumulators, which displace 600 cells of the common form of gravity battery, which has been the standard form of battery for telegraphing purposes for so many years past. In the matter of efficiency the storage battery has proven so much superior to the gravity that the company have decided to install these batteries at other important terminal offices. The battery is in duplicate, two sets of which are in service for 24 hours, while the other two sets are being charged or at rest. The period of charge is generally three hours for both the main and local batteries, and the current is supplied from the Electric Company's power circuit, to which the main batteries are connected direct, at the rate of 1½ amperes per hour, but for the cells which supply the "local" instruments it was necessary to reduce the charging pressure from 260 volts to 2½, which is done by means of a motor-generator, at a charging rate on the generator side of 15 amperes per hour. For wire service there are four battery "leads," paired negative and positive, to the switchboard, from which the current is taken at a pressure of 130 and 70 volts from each pair. To prevent an over-discharge to line in case of accident, each of the 115 battery discs on the switchboard is connected in series with the battery "lead" through an ordinary incandescent lamp, the voltage of which is 125, or 75 volts, as the "lead" may require. Should any wires become "crossed," or "grounded," the lamps on the wires affected will glow, thus acting as an indicator as well as preventing more than a safe amount of current from passing into the interrupted wires. The resistance of the magnet spools of the "local" sounders was increased from 2 ohms to 10 ohms each to prevent a short circuiting of the local cells.

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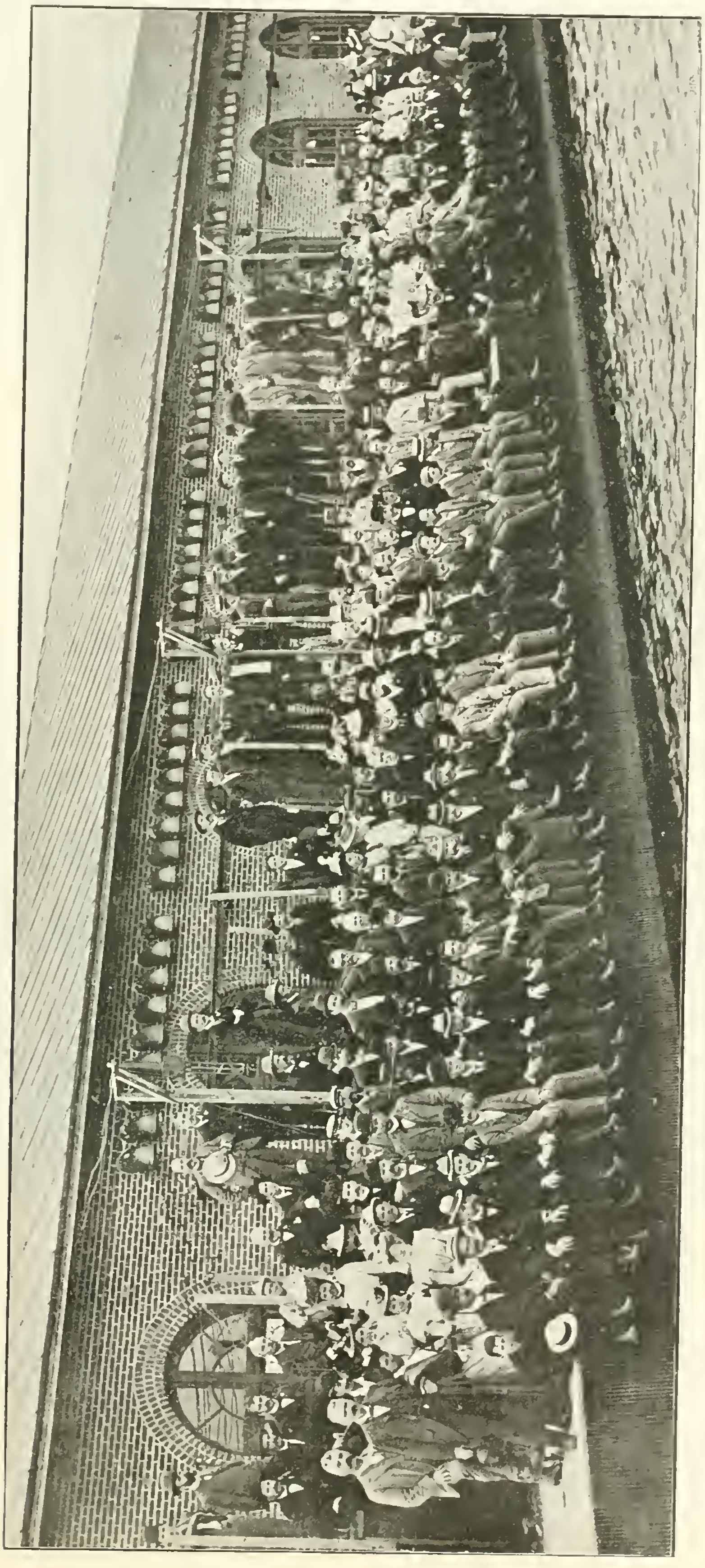


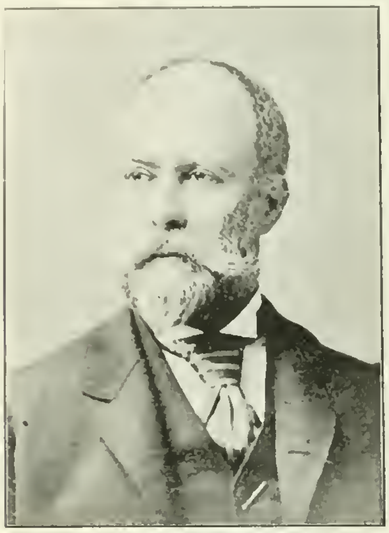
MEMBERS AND VISITORS, CANADIAN ELECTRICAL ASSOCIATION CONVENTION, MONTREAL, JUNE, 1898.

From photograph taken at Chambly.

MR. W. H. BROWNE.

The Canadian Electrical Association is to be congratulated upon having chosen Mr. W. H. Browne as its chief executive officer. Since his connection with the Association Mr. Browne has been recognized as one of its strongest pillars. Of his desire and ability to wisely direct the affairs and promote the interests of the Association there can be no question. His energy, earnestness and thorough business methods, as exemplified in the management of the Royal Electric Company, are sufficient guarantee on this point. In this he will be given valuable assistance by the two vice-presidents, Messrs. H. P. Dwight and A. A. Dion.

Mr. Browne was born in the year 1849, at Troy, N. Y. While engaged in the foundry and general hardware manufacturing business in the city of New York, he perceived the possibilities in the electrical field. Besides investing in other electrical industries, he became interested in and was one of the organizers of the electric railway at Richmond, Virginia, which was the first electric railway in the United States, the construction of which was commenced in 1888. He continued as manager of this road until 1891, and in addition had the management of the United Electric Light and Power Company, perhaps the largest concern of the kind existing at that time, which afterwards absorbed the United States Illuminating Company and the Brush Illuminating Company. In January, 1895, Mr. Browne accepted the management of the Royal Electric Company.



Mr. W. H. Browne,
President Canadian Electrical Association.

CONVENTION ECHOES.

Mr. Kammerer's pretty little Anglo-American flags were very much in evidence.

What's the matter with the new president and vice-presidents? Oh! they're all right.

Parlez vous Francais? If not, we may conclude that you are among the few who didn't attend the convention.

Mr. E. I. Jenking is not only a clever stenographer, but also an excellent singer and an altogether jolly good fellow.

Mr. F. A. Wunder, of New York, eastern manager for the Fort Wayne Electric Corporation, took in the convention. He was accompanied by Mrs. Wunder.

Three cheers and a tiger for the members of the Reception Committee Jolly good fellows every one—when shall we see their like again? "Hip! hip!" etc.

The excellent work done in behalf of the Association by Mr. Yule during his two years' term as president is recognized and held in highest appreciation by the officers and members.

Mr. Samuel Chase, of New York, representing the Western Electric Co., of Chicago, is well known to the electrical fraternity in Canada, and consequently was right at home with the boys at Montreal.

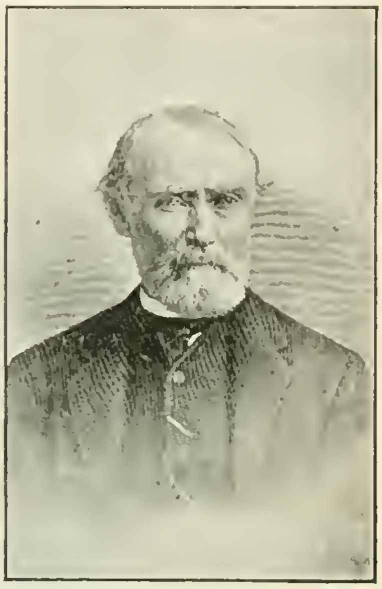
Mr. R. E. T. Pringle's handsome electrical display on St. James street was highly commended, as was also that of the Lachine Rapids Hydraulic and Land Co., corner of Craig street and Victoria avenue.

The absence from the banquet of Mr. C. F. Sise, president of the Bell Telephone Co., was much regretted. Mr. Sise is at present a victim of rhuematism, and therefore subject to the commands of his physician.

Conspicuous among the dispensers of hospitality throughout the convention was Mr. L. B. McFarlane, of the Bell Telephone Company, who constantly exerted himself for the success of the meeting and the pleasure of the visitors.

The sight of the genial manager of the Toronto Electric Light Co., wearing on his breast the combined flags of Britain and United States, was accepted by the members as indisputable evidence of the genuineness of the entente cordiale which is said to have recently been established between these nations.

It is to be hoped that Mr. Wm. Thompson, the indefatigable chairman of the Committee on Arrangements, has found time since the convention to enjoy the sleep which was so conspicuously absent a feature of his existence during convention week. Mr. Thompson has made a reputation for himself as a "hustler."



Mr. H. P. Dwight,
First Vice-President Canadian Electrical Association.

In addition to a number of interesting samples of electric cables, Mr. John Carroll, of the Eugene Phillips Electrical Works, presented to his friends a handsome souvenir of the convention in the form of an attractively covered folder, containing excellent portraits of Admiral Dewey and other prominent American commanders.

The Canadian General Electric Co., Limited, of Toronto and Peterboro', presented the delegates to the convention with a handsome and serviceable souvenir, in the shape of a paper weight made in miniature to represent a small induction motor. This little souvenir was much admired and highly appreciated by all who received one.

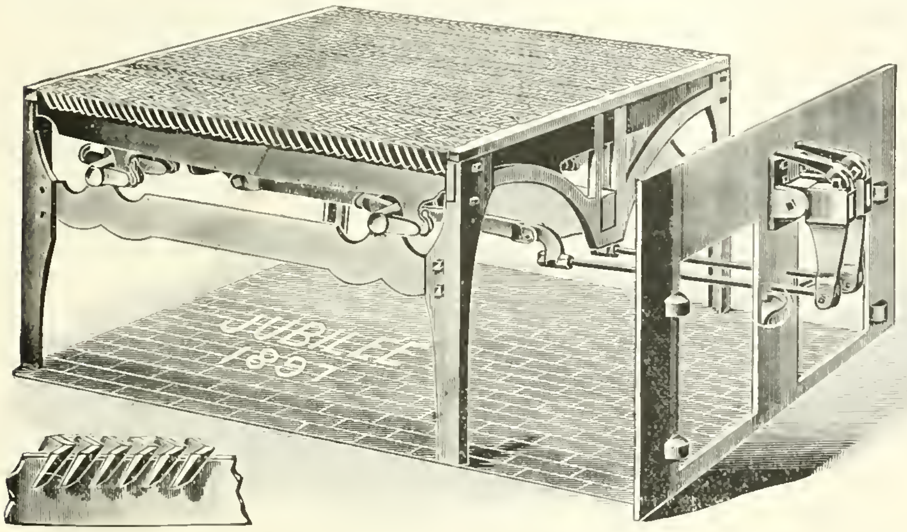
Mr. A. A. Dion,
Second Vice-President Canadian Electrical Association.

Some of the Montreal ladies were extremely thoughtful and kind to the wives and lady friends of non-resident members. It has been suggested that at future conventions, the pleasure of visiting ladies could be greatly enhanced by the appointment of a local committee of ladies, under whose direction points of interest might be visited during the progress of the business sessions.

Mr. H. O. Fisk, of Peterboro,' took in the convention city, but not the convention. The why and wherefore of his absence from the convention hall and the good fellowship of his brethren in the Association was the subject of many conjectures. We now feel at liberty to state that Mr. Fisk was compelled to choose between electrical technicalities and the society of his young and pretty bride, and he very wisely chose the latter. The members of the Canadian Electrical Association will join us in wishing the young couple a long and prosperous matrimonial voyage.

The wife of a well known member, who took in all the visits of inspection and asked the why and wherefore of everything she saw, has expressed her intention to prepare a series of lectures on electricity from a woman's standpoint. This preliminary announcement is made in order that the proposed departure may not prove too great a shock to the lady's husband and friends.

Mr. W. H. Browne, manager of the Royal Electric Company, and his excellent staff, placed themselves unreservedly at the disposal of the officers and members throughout the convention.



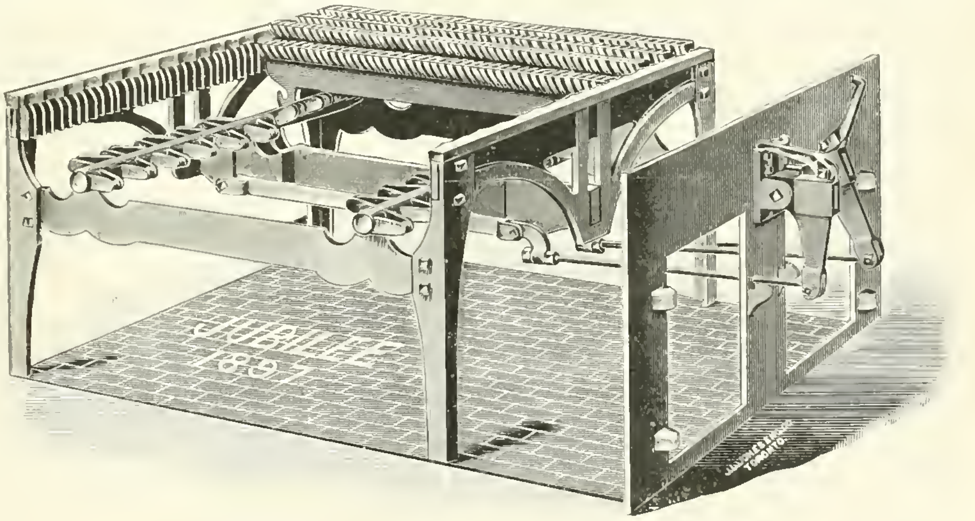
The Jubilee Shaking Grate.

It is needless to say to those who know them that they are a bright and cheery lot of good fellows, who do not count any effort too great that is calculated to increase the comfort and happiness of their friends.

Many of the members were glad to find Mr. R. G. Black, son of Mr. Geo. Black, of Hamilton, in charge of the Chambly Manufacturing Company's plant. Mr. Black, in addition to excellent natural ability, is a graduate of the School of Practical Science, Toronto, and has had a valuable experience in the factory of the Westinghouse Electric Manufacturing Co., at Pittsburg, Pa. Therefore in his present position he will no doubt prove to be the right man in the right place.

THE JUBILEE SHAKING GRATE.

We take pleasure in calling the attention of our readers to the merits of the Jubilee shaking grate. People who are interested in steam power and heating plants have been giving much attention to the cost of fuel used to generate steam, hot water or hot air, as the case may be. It has taken but little observation, when once put to the scrutiny of skillful engineers, to see that the old-fashioned way of burning coal on stationary bars, using hoes, slash bars, scrapers, hooks, slicing bars and other such fire tools to rid the ash and clean the fire did not prove an economical way of burning coal. This conclusion, settled by the observant engineer and fireman, opened the field for some appliance to take the place of the stationary bar.



The Jubilee Shaking Grate, with Some of the Bars Removed.

It will be observed by the illustrations presented that the Jubilee Grate Bar Co. appear to have embodied the essential points required in the construction of a shaking grate. The bars stand erect upon the rockers, presenting a perfectly smooth and level surface to the fire. When shaking, the bars have an up and down movement which thoroughly sifts the ash from the coal, allowing the air free access to properly oxidize the carbon. It is claimed for these grates that they evaporate from 10 to 20% more water per pound of coal, using slack or screening, and with natural draft, than can be evaporated when using select, lump or best steam coal on a stationary bar. Below is a summary of the prominent features which distinguish the Jubilee shaking grate:

It gives the greatest percentage of air space of any grate in the world, thereby insuring the most perfect combustion; ⅜ air space gives 57 per cent. air; 1-2 air space gives 70 per cent. air; ⅝ air space gives 78 per cent air.

It has 50 per cent. more under-draft than any shaking or stationary bar made.

The angle sections which protrude above the body of the bar, and form the top or surface of the grate, are set at such an angle that the air is carried in its natural line of flow without a break in its current, under and behind the coal.

Owing to the angular shape of the sections they gather the air in and over the top of the bar, thereby distributing the air evenly under the coal, besides keeping the bar cool.

It presents a perfectly level surface while at rest.

Owing to the perpendicular movement of the bars when shaking, the grate surface is cleaned equally without opening fire doors and without loss of fuel.

The Jubilee grate shakes from wall to wall, and has no stationary centre or side bars upon which the ashes and clinkers can collect.

The bars stand erect upon the rockers and are held in place by a projection on the end of the bars, which move in guides on end frames, which are well down below the fire, and by having nothing to interfere with expansion makes it impossible to twist or bend the bars.

The bars are held down to rockers by gravity hooks, doing away with the inconvenience of split pins and such methods.

It has a most unique and effective lock to hold the bars level.

It is easily adapted to any furnace.

It can be changed from one sized air space to another without removing anything but the bars.

These grates are manufactured and sold by the Jublilee Grate Bar Co., of Toronto, Limited, West Market street, Toronto; the Goldie & McCulloch Co., Limited, Galt, Ont., and the Laurie Engine Works, Montreal, Quebec.

PERSONAL.

Mr. A. Bingham, manager of the Bell Telephone Co., has resigned, and has accepted the position of manager of the St. Thomas electric railway.

Mr. E. Round, of the Peterborough Light & Power Company, was a recent visitor at the office of the Electrical News. Mr. Round has been connected with the above company for fourteen years.

Mr. I. H. Breck, electrician, of Kingston, Ont., is receiving the congratulations of his friends upon the occasion of his recent marriage to Miss McLeod. Mr. Breck is a son of the president of the Kingston Electric Railway Company.

Before leaving to assume his new position with Messrs. Dick, Kerr & Company, of London, England, Mr. F. C. Armstrong, late of the Canadian General Electric Company, was tendered a farewell dinner at the Board of Trade restaurant in Toronto.

McCurdy & Co., Antigonish, N. S., are enlarging their electric light plant, and have a contract to light the streets of the town. A 60 h.p. engine and boiler has been ordered from the Robb Engineering Co.

An effort is being made to form a company in London, Ont., in opposition to the Bell Telephone Co. It is stated that Messrs. Walter & Evans, of Detroit, and J. Minhinnick, F. B. Leys, T. Smallman, and others, of London, are interested, and that the charge for instruments will be $18 for house service and $25 for office service per annum.

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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

CANADIAN ELECTRICAL ASSOCIATION.

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1ST VICE-PRESIDENT:
H. P. DWIGHT, President G N.W. Telegraph Co., Toronto.
2ND VICE-PRESIDENT:
A. A. DION, Superintendent Ottawa Electric Co, Ottawa.
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WILLIAM THOMPSON, Superintendent Waterworks and Electric Light Plant, Montreal West, Que.
W. McLEA WALBANK, Lachine Rapids Hydraulic & Land Co., Montreal.
G. J. HENDERSON, Hamilton Electric Light & Power Co, Hamilton.
H. R. LEYDEN, Manager Cataract Power Co., Hamilton.
GEO. BLACK, G.N.W. Telegraph Co., Hamilton.
E. E. CARY, Manager Packard Electric Co., St. Catharines, Ont.

Articles Omitted.

THE space required in this issue for a report of the proceedings of the convention of the Canadian Electrical Association renders it imperative that several articles previously arranged for be held over until our August issue. Among these are the last of Mr. Thompson's series of articles on "Corrosive and Scale Forming Agents in Boiler Feed Waters," and the conclusion of Mr. R. A. Ross' paper on "Electrical Power Transmissions."

Canadian Electrical Association Convention.

THE recent convention in Montreal of the Canadian Electrical Association was, without doubt, the most successful yet held. The arrangements were complete in every respect, the attendance large and representative, and the proceedings unusually interesting. At a meeting of the Executive Committee held prior to the convention, over sixty new members were elected. The Association is now in a prosperous condition, and continued growth is assured. Lack of space prevents a more extended reference to the convention proceedings.

Assessment of Poles, Rails and Wires.

ELECTRICAL companies will await with much interest the decision of the Privy Council in England with regard to the validity of the assessment imposed on the rails, poles and wires of the Toronto Railway Company, inasmuch as the result will affect not only street railway companies, but also gas, electric light, telephone and telegraph companies. In the city of Toronto alone, an assessment on the various companies of more than two million dollars is involved, which would give a yearly revenue of at least $34,000. The question has been before the Ontario courts for four years, but the decisions already given provide little ground on which to forecast the final result. The Supreme Court decided that the gas mains of the Consumers' Gas Company are liable to assessment; Judge McDougall held that the rails, poles and wires of the Toronto Railway Company are also liable to assessment. Judges McGibbon and Dartnell ruled that the above equipment of the Toronto Railway Company is exempt from taxation, but the Court of Appeal for Ontario has reversed this decision, and it is from this last decision, which is final until overruled by the Privy Council, that the appeal is now being taken. The question which the Privy Council must decide is whether or not the equipment, such as rails, poles, wires, mains, etc., of a company, is real or personal property. If real property such equipment is assessable; if personal property it is exempt from taxation, the Assessment Act of Ontario providing that the personal property of a company which invests the whole or the principal part of its means in gas works, waterworks, railways, and such like, shall be exempt from assessment. There are many debatable points in connection with the case, and no prediction as to the outcome can safely be ventured.

Cost of Power for Generating Electricity.

IN a paper read before the National Electric Light Association, Mr. W. McLea Walbank, of Montreal, gives some calculations as to the cost of producing power from the Lachine Rapids for the generation of electricity. His estimate includes the cost of developing the power and delivering it on the bus-bars at the sub-station, in which the cost of step-down transformers and the drop or loss in power from the rapids to the station must be taken into consideration. Of a total installation of 72 wheels, 48 are already in place. About $1,000,000 has been spent in hydraulic development, which will furnish 20,000 horse power, but until a market is found for the total power, some 5,000 horse power will have to be charged with the expense of hydraulic development of the total 20,000 horse power. Therefore Mr. Walbank, in his paper, gives, first, the cost per kilowatt per year for the portion of the plant at present installed, and, second, the cost when the whole water power development will be in operation. In the first instance the cost of water rights, hydraulic machinery, etc., is $957,200, and the power delivered at sub-station, allowing for loss, 3,600 kilowatts, which is equivalent to $263.83 per kilowatt, capital cost. This, at six per cent., would be equivalent to $15.95 per k.w. The depreciation on $300,000, representing the cost of that portion of the plant subject to depreciation, at 5 per cent., would be $4.17 per k.w., and the operating expenses, including repairs, insurance, etc., $2.85 per k.w., giving a total cost on a twenty-four hour day basis of $22.97 per year per kilowatt. Taking the completed plant, with 72 wheels installed, the cost is given as $1,113,273. The power developed, after deducting losses, will be 13,500 kilowatt at the bus-bars, equivalent to $82.46 per h.p. capital cost, which, at six per cent., represents $4.95 per kilowatt annually. Allowing $1.68 per k.w. for depreciation and $1.51 for operating expenses, the total cost per annum will be $8.14 per kilowatt. Attention is directed to the fact that the operating and depreciation expenses per kilowatt will be very much reduced when the entire hydraulic equipment is put into operation. It is stated that Nova Scotia coal, costing $3.50 per ton, is used.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE EIGHTH ANNUAL CONVENTION

THE Eighth Annual Convention of the Canadian Electrical Association was held, pursuant to announcement, at the Windsor Hotel, Montreal, on Tuesday, Wednesday and Thursday, June 28th, 29th and 30th.

The first session opened at 10 a. m., with the President, Mr. John Yule, in the chair.

There were present the following members :—

L. B. McFarlane, John J. York, H. O. Edwards, F. W. Fairman, John Shaw, Wm. B. Shaw, John Carroll, P. H. Hart, N. W. McLaren, Fred Thompson, E. Craig, C. H. Wright, Geo. W. Sadler, R. S. Kelsch, W. E. Gower, George A. Childs, James A. Baylis, Moses Rubenstein, N. C. Ross, D. S. Barton, Wm. T. Bonner, Wm. H. Browne, J. E. Scott, M. P. Cochrane, Louis A. Herdt, P. G. Gossler, L. D. W. Magie, H. J. Fuller, Thomas Rodger, D. W. McLaren, P. H. Davidson, George E. Mathews, Alex. Barrie, E. Carter, W. B. Powell, H. H. Henshaw, R. E. T. Pringle, A. W. Staveley, H. G. McLaren, W. F. McLaren, W. McLea Wallbank, J. A. Burns, R. Dobie, L. A. Howland, E. A. Wallberg, F. H. Leonard, jr., W. J. Plews, J. W. Pilcher, D. Sleeth, Montreal, Que. ; W. A. Johnston, Wm. McCaffrey, E. B. Biggar, A. M. Wickens, A. B. Smith, J. J. Wright, J. W. Campbell, Walker G. Anderson, E. D. McCormack, Joseph Wright, J. K. Johnstone, J. J. Ashworth, C. H. Mortimer, J. A. Kammerer, Toronto, Ont. ; A. A. Dion, W. G. Bradley, Wm. Ahearn, jr., C. Thompson, E. J. O'Reilly, James Johnston, R. Anderson, Ottawa, Ont. ; F. W. Martin, George Black, John P. Rigsby, Gordon J. Henderson, Hamilton, Ont. ; Charles B. Hunt, C. E. A. Carr, London, Ont. ; B. F. Reesor, Thomas Sadler, D. McGribben, P. Morgan, Lindsay, Ont. ; E. E. Cary, D. H. Henderson, G. A. Powell, St. Catharines, Ont. ; W. R. Leet, E. A. Wright, Danville, Que. ; J. J. Mahoney, Samuel A. Chase, W. R. McLaughlin, F. A. Wunder, New York, N. Y. ; John Yule, Guelph, Ont. ; William Thompson, Montreal West, Que. ; J. W. Purcell, Walkerville, Ont. ; Geo. D. Ellis, Barrie, Ont. ; A. A. Wright, Renfrew, Ont. ; H. A. Moore, Trenton, Ont. ; W. F. Simmons, Kingston, Ont. ; A. L. Breithaupt, Berlin, Ont. ; V. B. Coleman, Port Hope, Ont. ; E. J. Kyle, Merrickville, Ont. ; J. F. H. Wyse, Brantford, Ont. ; Andrew Sangster, Sherbrooke, Que.; Alfred Stearns, Brussels, Ont. ; W. A. Fenn, Buffalo, N. Y. ; J. A. Hunter, Vancouver, B. C. ; Stephen Noxon, Ingersoll, Ont. ; P. Bowler, New Westminster, B. C. ; George W. Thompson, Belleville, Ont. ; S. E. Fletcher, St. Johns, Que. ; H. R. Carruthers, Millbrook, Ont.

The Secretary-Treasurer read the minutes of the last annual meeting of the Association, held at Niagara Falls, June 2nd, 3rd and 4th, 1897, which were approved.

His Worship, Mayor Prefontaine, of Montreal, was then introduced to the President and the Association, and made the following address :

Mr. President and Gentlemen :—In the name of the citizens of Montreal, I heartily welcome you to our fair city. The Association to which you belong is one of the most important Associations of the century. The science which you study is one which can be called the science of the 19th century, although immense progress and discoveries had been made previous to then.

It is not necessary for me to enlarge more upon the question, as I hope that I will have the pleasure of meeting you at the banquet, but this morning, let me only repeat again that we are glad to see you here amongst the citizens of Montreal.

I know the work you will do will bear fruit as regards the prosperity of the science which you study.

I, therefore, as chief magistrate of the city of Montreal, declare the eighth annual convention of the Canadian Electrical Association to be open, and I trust your stay will be pleasant, and hope that you will be favored with fairer weather than you were this morning, as otherwise you will obtain a poor opinion of our climate.

I hope the stay that you will make in the city of Montreal will be both useful and enjoyable.

The President : We are all very much pleased to see His Worship here, and I call on Mr. Wright, of Renfrew, to thank him for his kindly address.

Mr. A. A. Wright : I am very sorry for two things—one is that I was not born a French-Canadian, in order that I might have all the eloquence which, you know, is supposed to flow in the veins of those good people ; and another thing for which I am sorry is that I was not born in Ireland, in order that I might have lived near the "blarney stone." I may say that I have made full arrangements that when I come to be born again, all these little difficulties will be overcome. I am sure that, as an Association, we are delighted with the flattering address which has been made to us by His Worship, the Mayor of Montreal, and the hearty welcome ; and in looking over the programme that our good friends here have arranged for us, I am sure that there will be only one opinion with regard to the excellence of it. You know that entertainments such as these are not sold by the pound, as the grocer sells his tea, nor by the yard, as the dry goods man sells his cotton, but they are the spontaneous outcome of noble and generous hearts, and those are the kind of hearts possessed by the citizens of Montreal. This is a progressive and illustrious city. Cities are made of men, consequently the people of Montreal are illustrious, because we have in the city of Montreal some of the most illustrious and liberal men on the face of the globe liberal to the art of electricity —and we believe they have done and will do all they can to make this meeting one of the best we have ever had. I thank His Worship, the Mayor, for his kind address, and we thank the good people of Montreal for the entertainment we expect to receive while we are here during the next few days.

The President then read his annual address, as follows:

PRESIDENT'S ADDRESS.

I beg to give you all a hearty welcome to this the eighth convention of the Canadian Electrical Association. The aim of the Association is to gather together the members of the electrical fraternity and allied interests for the purpose of mutual discussion, and to learn from each other's experience. In this way we try to benefit the whole business interests with which we are all connected. An organization of this kind confers upon its members benefits from the reading of papers, and the discussions which take place disseminate information with reference to the methods that are constantly being tried by different members in the practical conduct of their every day operations and business methods. This Association affords the means for members to become acquainted with one another. The friendships here formed should be used for the purpose of mutual protection and advice when difficulties arise. A free and friendly correspondence tends very much to strengthen, stimulate and encourage many of us in our daily struggle with difficulties. It is a matter of satisfaction to me that during the last two years you have honored me with the office of President, good progress has been made in the direction indicated ; but there is still room for great improvement.

It is now almost four years since the last meeting of the Canadian Electrical Association was held in the city of Montreal During the interval conventions have been held, once in Ottawa, twice in Toronto, and last year at Niagara Falls On each occasion matters of current interest and importance have been presented for the consideration of our members. There are many reasons why our meeting again this year in the east, and particularly in Montreal, should be at once a source of both pleasure and profit to the members of this Association The intervening four years have done much for the Dominion of Canada, for its national life and the development of its material resources. In no department of industry has this progress been more marked than in the electrical field, in electric lighting, in electric railway work and in the electric transmission of power ; and the work must not be forgotten which has been done in extending the use and improving the service in the older branches, the telegraph and the telephone. From this development of the great modern industry in which we are all proud to have a share, no part of the country is likely to reap greater benefits than the city of Montreal and its vicinity. The Dominion of Canada, at least so far as Ontario and Quebec are concerned, while otherwise abundantly dowered with mineral riches, has been deprived of coal deposits, until recently an essential factor in manufacturing and industrial development To-day, however, the possibilities of electrical transmission have rendered available as a substitute to turn the wheels of our factories, the heritage which both provinces possess in their abundant water powers It will be our privilege to inspect what has been done in this direction by some of her far-sighted and enterprising citizens for the city of Montreal. We shall first see that great enterprise, carried out in the face of difficulties and discouragements, the successful utilization of the power of the St. Lawrence river by the plant of the Lachine Rapids Hydraulic and Land Company. Of equal interest and importance will be the opportunity given of inspecting the plant and equipment of the Chambly Manufacturing Company on the Richelieu river at Chambly, which will vie with its great rival in the benificent work of supplying cheap light and cheap power for the citizens of Montreal. It is to be hoped that a fair dividend will be the reward of the shareholders of the two companies for their enterprise.

It is proper, before entering on the work of this convention, that we should glance briefly over the progress of the past year. A marked feature of electric progress in the Dominion throughout the years 1897 and 1898 has been the inception, and, in some cases, the completion of a number of important plants for the long distance transmission of power In the province of Quebec there are, besides the two plants already mentioned, the Montmorency plant, which has been in operation for several years, and is no doubt familiar to most of you, and the North Shore Power Company, Three Rivers, a 10 mile transmission, 12,000 volts, delivering 500 k.w. In Ontario there is the Cataract Power Company, of Hamilton, the distance to be transmitted 33 miles, pressure 25,000 volts, with a capacity of 6,000 horse power. This plant, it is anticipated, will be in operation by August 1st next In British Columbia a transmission installation of 1,500 horse power capacity is being erected to supply energy for the electric railway, lighting and power industries of the city of Victoria, distance 16 miles. The West Kootenay Power Company recently started with an initial capacity of 2000 horse power, pressure 20,000 volts, distance 30 miles This power will be used for the operation of machinery in the mining districts We have already referred to the enormous development under way in the vicinity of Montreal. The only point at which satisfactory progress cannot be reported is at Niagara Falls, where, unfortunately, the tying up of the greatest water power in the Dominion in the hands of an alien corporation has prevented its development for the benefit of the people of Ontario. This state of affairs, we trust, will be removed before another year

Besides the important plants mentioned which are either in operation or in course of construction, a large number of similar enterprises are at present in their initial stages and may be expected to reach their completion within the next year or two. Altogether, it is difficult to foresee at the present moment the benefits which our Canadian manufactories and industries generally may derive from the utilizing of the water powers of the country, scattered without number from the Atlantic to the Pacific. In electric railway work the development of the year has been mainly confined to the extension and the better equipment of existing city and suburban roads. In the field of electric lighting, in which a majority of the members of the Association are more particularly interested, a reasonably satisfactory condition of affairs exists. That industry is on a fairly solid basis, at least in so far as a distribution of current for incandescent and power purposes is concerned, as rendered evident by the failure of the much talked of illuminant of the future, acetylene gas, to make any inroad into the field of the lighting companies. A large majority of the plants now in operation are equipped with reasonably modern and efficient machinery, and the rates at which current is supplied are, it is safe to say, if taken on the average, the lowest in the world.

We will have before us the report of the Committee on Legislation. From this you will see how far the efforts made since our last meeting have been successful in the direction of securing equitable protection of private investments. It is to be hoped that the work of the Association during the convention will be helpful to the members, and that they will recognize the value they receive from their attendance here with respect to the papers which have been prepared for the convention. You will see their practical and helpful nature, and I trust you are ready to criticize and discuss the views set forth in the light of your own experience.

One thing more I feel should be mentioned, and that is, the appreciation of the efforts of the different companies and individuals in Montreal who have so heartily co-operated for the success of this meeting The proverbial hospitality of our metropolitan city is known to you all. A pleasing feature of our last convention was the regular and prompt attendance of members at all sessions and the keen interest taken in the proceedings. This commendable practice will, I trust, be kept up at this our eighth convention now open for business.

The conclusion of the address was greeted with prolonged applause. The President then called on Mr. J. J. Wright to read the report of the Committee on Meters.

Mr. Wright stated that there was no special business to bring before the Committee on Meters during the past year, consequently it was not convened, and there was no report to make on behalf of it.

The President appointed Messrs. Reesor, Smith and Hunt as members of a committee to strike the standing committees for the year.

The President : The next item is general business that any of the members may wish to bring up, or any questions they desire to ask. We will be very glad to hear from anybody who has anything to say.

Mr. C. B. Hunt : I would move that the Report on Legislation be taken up the first thing to-morrow morning. This will give the members a chance to read it over ; we cannot very well discuss it until this has been done.

The President : This appears to be all the business set down for this session, but I think it advisable to now have one of the papers read, and will ask Mr. A. A. Wright to read his paper entitled, "How to Overcome Some of the Difficulties Encountered by Central Station Men." (See page 143.)

DISCUSSION.

Following the reading of his paper, Mr. Wright made the following remarks : If I may be allowed the time, there is one thing more that I wish to refer to. Perhaps it cannot be done in every instance, but there is one thing I would advise central station men to do, that is, where they have contracts with a town unless they are situated under very favorable conditions, as in some certain towns that I know of, where the owners of the plant pretty nearly own the town itself, where you do not own the town, but the town, rather, owns you, so far as electric lighting is concerned I would advise everyone to try and form a joint stock company, and not endeavor to run the concern alone, no matter how great their abilities are. Try and get the most influential men in the town as members of the company, and in that way you will have a leverage on the council that you cannot otherwise possibly obtain. It will also prevent other companies from coming in, and will assist you in many ways. I just throw out this as a suggestion, so that if anyone contemplates the formation of a joint stock company, they will try and get as influential men as possible, as it is hard to know sometimes where the lightning will strike. Another thing I would like to mention is that it is well to try and let your lighting contract with the town be the weak arm of your strength, and devote more time to the commercial aspect than to the other ; then if you do not get the desired legislation, you will be in a better position to stand the shock than otherwise.

The President : We have listened to Mr. Wright's interesting speech, and we would like to hear from others as to their experience on any of the points mentioned by Mr. Wright. Mr. Wyse, of Brantford, may be able to say something.

Mr. Wyse : I have listened with a great deal of interest to Mr. Wright's paper, especially as it covers many points in relation to experiences that I have lately been through in dealing with the municipal authorities at Brantford, and I think it is something that all central station men and probably very many others can appreciate. There was one point that I would like to ask Mr. Wright about, and that is the collection of bills. He speaks of collecting weekly. Would you not, Mr. Wright, find that this would require a larger office staff than otherwise.

Mr. Wright : That refers to the arc lighting accounts. The man who goes around trimming collects these bills and the incandescents are collected every month.

Mr. Wyse : I thought that referred to your private incandescent customers.

Mr. Wright : No, we collect those monthly.

Mr. Wyse : We find that there are a great number of customers who, as you say, will pay a small bill rather than let a large one run on. There was another thing that I would like to bring to the attention of the members, that is, giving notice. We find that giving notice where the account is not paid promptly is very effective. We have a system of first, second and third notice, and if the bills are not paid after the third notice we disconnect the customer, and this generally results in his paying the bill and asking for re-connection. I think Mr. Wright deserves the thanks of the Association for his very valuable paper.

Mr. Wright : With reference to the insertion of that saving clause, this year I just succeeded in getting it, to use a common phrase, by the skin of my teeth—"one day saved me." It is very difficult sometimes to get that clause inserted. You all understand that there are certain men in the council that you can approach and others that you can not. Just how to get this clause inserted is often difficult. Some of you, I suppose, have sometimes to make up a contract yourself. It don't do to come out straight and say "Here, I want to have this resolution moved," especially as one has to deal with a number of men who are not any too well up. Be sure in making up the resolution to give it to a man who will bring it into the council without any hesitation. This is one of the difficulties I find in getting the thing brought before the councillors.

Mr. Wyse : Could you not arrange to get a longer contract than one year in most instances?

Mr. Wright : I would like to do so.

Mr. Reesor : What is the population of Renfrew ?

Mr. Wright : Between three and four thousand.

Mr. Hunt : Do you supply incandescent lights entirely by meters or on flat rates ?

Mr. Wright : Almost entirely by meters.

Mr. Hunt : Do you charge a meter rental ?

Mr. Wright : Yes ; twenty-five cents a month on all sizes.

Mr. Hunt : What is the smallest size meter that you have ?

Mr. Wright : 7½ ampere, 3 wire, and we also use 2 wire.

Mr. Hunt : You can now get 5 ampere meters for your 2 wire service that will start on a 5 c.p. lamp.

Mr. Wright : I did not know that there was one that would respond to a 5 c.p.

Mr. Hunt : There is, and we have about 50 in use of the General Electric type.

Mr. Wyse : The Shallenberger meter can also be obtained in 5 ampere size.

Mr. Reesor : As far as Lindsay is concerned, we make monthly collections on incandescent lighting, and the town lighting is also collected monthly. The incandescent lighting and commercial lighting we collect monthly, and we have a rate of discount of 33⅓% if the bills due on the 1st are paid before the 10th. We find this works fairly well. They come to the office and pay, and we are trying to have all of our collections made at the office instead of sending out collectors. Of course we have a few delinquents, but we are trying to weed these fellows out, or educate them to a better system.

Mr. A. A. Wright : Have you everything in your own hands ?

Mr. Reesor : Yes ; we had two companies, but the other one has been absorbed.

Mr. A. A. Wright : Of course you can see the advisability of collecting your arc accounts every week instead of monthly. We could not work that lamp scheme with them.

Mr. A. L. Breithaupt : I find the system of sending notices very effective. We have in Berlin a number of customers who are intentionally delinquent, and who simply do not want to pay their bill, though they want the light. We found a very effective way to be to send them notice that unless within 48 hours the account was paid, the current would be cut off. We applied that both to our electric and gas customers, and find it works very well. We collect monthly, and try to render our accounts on the 1st. Sometimes they don't go out until the 2nd, and if paid by the 10th we allow 20% discount, that is, bringing it down to a net basis. Most of our bills are paid in the office, except a few of the business men near our office, which we collect ; but most of our people pay at the office.

Mr. A. A. Wright : You have no opposition in your town.

Mr. Breithaupt : No.

Mr. Wyse : I would like to ask Mr. Wright if he has any opposition in Renfrew.

Mr. Wright : Oh ! we have two others.

Mr. Wyse : In a town of 3,500 ?

Mr. Wright : Yes. Why, in Eganville, which has a population of about 1,500, they have two companies, and pay $50 to the government—$25 each.

The President : Mr. Wright speaks about gathering influential men about you. The great trouble about these men is that they don't stay influential, and don't stay with the council, but stay with the company, and sometimes incur the hostility of the aldermen for not being in harmony with them. In our campaign, I made up my mind that it had to go to the vote. I did not speak to a single member of the council until the whole thing was over, but just prepared, and let it go through, and about two weeks before the by-law came out I got in my work, and instead of them hunting me, they were on the defensive themselves. I had been preparing carefully for six months. The situation was such that I did not think it was any use to deal with the council at all, but simply stand on common sense and put your case before the freeholders. Fortunately in Ontario it is only those who have property that can vote on a by-law, and this is a large protection. There is an inclination among the property holders not to trust the council with any more money or property than they can get at present. Referring to the system of collecting and sending accounts, we have weekly, monthly and quarterly accounts. The quarterly are the residences and best business places and the stores. The monthlies are billiard rooms, barber shops and taverns, and any customers whom we think it best to place on the monthly. For the weekly, as well as the monthly, we have a collector who calls for the account, but the quarterlies are paid at the office. We have arc, incandescent and power—in fact, a little of everything. In a small town such as we have, we know everybody and know how to handle everybody, whether as individuals or classes, and can tell the best way to treat them.

Mr. A. A. Wright : Although we present our accounts every month, circumstances will, as you say, alter cases.

Mr. Wyse : Could you not save the expenses of that collector by offering a discount off the bills if paid at the office ?

The President : You know all these discounts are put on before they are taken off. They are looked upon as a penalty, not as an advantage. The way I look upon discounts, with about 10,000 inhabitants, it is more a penalty than a reduction on the account.

Mr. Dion : I would like to say a word regarding 5 c. p. lamps. We supply lamps free to our meter customers. We have confined ourselves to 10 and 16 c. p. lamps, but a few years ago, customers finding out that lamps of 5 c. p. were made, asked for them to be used as night lamps. Most of our small customers could not afford to burn a lamp all night if it were 10 c. p., and we finally decided to let a customer have a 5 c. p. lamp, only supplying one, and when that burned out exchanging it for a new one. We found it popularized electric lighting in that way, and prevented customers from using coal oil lamps. These night lamps, while not registering on the meter, are small expense to the company, as the load is small at the time when they are used, and we have found it an advantage to allow them to be used in that way.

Mr. Reesor : Sometimes when we make contracts with flat rates for 16 c. p. lamps, we have had difficulty by reason of our customers placing 32 c. p. lamps in their stead.

Mr. Dion : We have a small number of customers on flat rates where there is danger of changing 16 c. p. lamps for 32 c. p., but we make an inspection of all these premises three or four times a year and have reports made so that we can keep a pretty fair check on the lamps.

Mr. Reesor : Where are you living ?

Mr. Dion : In Ottawa.

Mr. Hunt : I would like to ask Mr. Dion whether he supplies on both flat rate and meter systems.

Mr. Dion : About an eighth of our business is a flat rate one. We supply the lamps in the first installation and renewals are paid for. On the meter system we supply all lamps free—both first installation and renewals. I may say we do more than that. We have found that customers on the meter system allow their lamps to get very old and black until they hardly give any light and then complain to their friends without coming to the office, so that we have no means of remedying the difficulty. Now we have a house to house inspection for the purpose of putting things in order. The inspector gives attention to loose sockets, etc., and also replaces any lamps that had better be out of service. Although an expense, we think the satisfaction to customers more than reimburses us.

Mr. Ellis : Referring to collections, I think we have a unique system of collections in Barrie. We send the account out every six weeks. We have a form with a coupon on the end, which states that "this bill is payable at the bank 15 days after date of issue." If not payed at the bank, customers don't receive the discount. If tendered after the 15th day, the bank won't accept it. We find this system very successful. We pay the bank $50 a year.

Mr. Hunt: What do you do with the person who does not pay and lets the account run?

Mr. Ellis: When the bank make their returns, we use for delinquents a printed slip which says: "Your account payable at the Bank of Commerce is still unpaid. If not paid within 10 days, your light will be shut off and the account placed in the hands of our solicitors for collection." The discount granted is 30 per cent.

Mr. Hunt: If a customer pays on the second month, will you allow the discount?

Mr. Ellis: No; we keep charging the discount.

The President: I never went to court with a single customer.

Mr. Ellis: We very seldom find it necessary, and of course have to make allowances with some people. Sometimes it is impossible for them to pay at the bank, owing to their being absent from town, etc., and if only a day or two late we don't mind, but the other class of people we don't accept.

Mr. Wyse: How do you arrange with your customer for cash discount?

Mr. Ellis: In sending the bill, we put down the gross amount and deduct the cash discount to be allowed. The contract is made at the gross price.

Mr. Hunt: What do you charge per 1,000 watts?

Mr. Ellis: We charge 17½ cents per 1,000 watts net, and if the bill is over $12 in six weeks, we give a discount of 20 per cent.; our gross rate is 25 cents per 1,000 watts.

Mr. Browne: Do I understand that you give 20 per cent. discount from 17½ cents net in cases where the bills are $12 in 6 weeks?

Mr. Ellis: Yes.

Mr. Hunt: I have great pleasure in moving a hearty vote of thanks to Mr. Wright for his very valuable paper and for the discussion that it has brought out. I think it has been very beneficial to all of us.

Mr. A. B. Smith: I have great pleasure in seconding that, and I hope Mr. Wright will have the same success with his city fathers in the future that he seems to have had in the past.

The session was then adjourned until 2:00 p.m.

AFTERNOON SESSION.

The convention resumed at 2:00 p.m.

The President read a telegram from the Ottawa Electrical Association, wishing the convention success, profit and pleasure, sure to be derived from a meeting in the Canadian metropolis.

Mr. Magie's paper on the "Electrical Utilization of Water Powers" was then read by Mr. W. H. Browne. (See page 21).

DISCUSSION.

Mr. A. A. Wright: If not out of order, I would like to ask if the position of permanent reader of papers is open; if it is, I would like to move that Mr. Browne be offered the situation. (Laughter.)

The President: This is a very important paper, and I would like you to carefully discuss it and ask any questions you may wish.

Mr. Wm. Thompson: I really have to regret that I did not have the opportunity of seeing Mr. Magie's most remarkable paper before, and I say "remarkable" advisedly, because he has covered the whole ground, which is something that writers of papers seldom do. I regret that this paper has only reached our hands to-day. I can quite understand that Mr. Magie, the writer of this paper, is not to blame for this, because, as we all know, he is a very busy man, but this paper covers too many important points in electrical engineering to enable one to attempt to thoroughly discuss it without thorough study. There are, however, one or two points brought out very forcibly, and those of us who have felt the progress of electrical engineering during the last five or ten years, can appreciate the importance of the information that is given within the columns of this paper. I, myself, have barely turned 30 years of age, and still I can distinctly remember my grandfather who ran a mill in Yorkshire, having in operation one of those huge wheels about 30 feet diameter. I can distinctly remember a "chap," as they would say, coming up from London and asking why he did not have buckets attached so that the water could drop into them. These were put on, and it was a remarkable fact to me that that mill, instead of turning out a few barrels per day, increased its capacity by more than four times. To my mind, the most important point in Mr. Magie's paper is the fact that evidently water wheels and water motor installations have come to stay. We have this evidenced by plants all over Canada, some of which have been very successful, others almost total failures. As it is the investor who produces the money for the electrical engineer to carry out his ideas, it is wise to remember that there are times when such installations as these are not advisable. I feel almost sorry that our large installations in the vicinity of Montreal are not further advanced, so that we could see or begin to appreciate the profits which the investor will receive from his capital in those large concerns. While passing Lachine Rapids one day I noticed that they had only two generators running. Now, they have a capacity there of something like 20,000 h.p., and they have been operating this plant for some little time. Possibly the total expenditure has been in the vicinity of a million and a half, but it struck me that there was going to be an immense lot of capital tied up in that plant for years to come without its earning any profit for the investor. If this had been a steam plant installation, it could have been made as the plant was required. This opens a large field for discussion, so much so that I do not feel like entering it, because I might, to use a vulgar expression, "put my foot in it." For this reason I would like to have had time to study Mr. Magie's paper very carefully and have prepared myself, and I feel almost like asking that this paper be carried over until next year, postponing the discussion until the next convention. The paper has far too much important matter in it to be laid on the table, simply read and allowed to drop.

Mr. Bonner: I think it is a very excellent suggestion of Mr. Thompson's that the paper be left over until next year, but I think there are one or two statements made somewhat disparagingly towards steam men. Representing one department of the steam power business, I have just a little to say on these points, but am unable to get actual data so as to place it before the members in an interesting and valuable way. We have not at the present time any data pertaining to Canadian plants which would be of special value to the Association, but it is my hope that during the next six months we will be able to make some tests on one or two complete plants, and if such is the case, I should like very much to present that data in the shape of a paper at the next meeting, and have that considered, perhaps, in connection with this suspended discussion of Mr. Magie's paper.

Mr. Browne: While I appreciate the importance of a very extended discussion of this paper, I fear that the postponement of it for a year may bring us, perhaps, into other phases of the subject, and that the present phase will be practically lost sight of. There are several gentlemen here, I think, abundantly competent to discuss the points thrown out by Mr. Magie's paper, and in order to perhaps provoke discussion and have a little contention on it and brighten the meeting, I may refer to Mr. Bonner's statement that there appear to be some aspersions cast on steam plants. I was conscious during the time of reading that Mr. Magie had been careful to point out that an expenditure on original installation, beyond a certain amount, prohibited competition with steam, and I believe, from what I know of the author and the preparation he gave the paper, that he recognizes the fact that there are many water power installations that should not be installed, because the conditions could be met equally by steam. But there is this one important character about water power transmissions, that, assuming that you are able to serve power during 10 hours a day, from a water fall, at the same price or even a little less than steam, you still have the opportunity of obtaining a revenue from the water power during other times of the day without any additional cost. You cannot obtain that additional profit with steam plant without additional cost, and the future of the water power transmissions seems to me to be in the direction of the utilization of the power in other hours of the day than the usual ten hours, namely, from 7 a.m. to 6 p.m. I may say that already in the city of Montreal probably the largest commercial enterprise has negotiated for electric power, and has made a change in its hours of operation in order to obtain the advantages and benefits of electric power. If that power had to be produced by steam, they simply could not enjoy the benefits, because they could produce the power for less money. This is an advantage that will develop to a larger extent than now with the power from water falls being used at other times of the day than has been the custom in using steam power.

Mr. A. A. Wright: I do not wish to be known for my much speaking, but I am afraid if I keep on that I will. It seems to me, however, that this paper is a very opportune one, and I may say that the fact of its being read was one of the inducements for my being present. It seems that if there is one subject more than another that is of interest to investors to-day, it is the development and utilization of the numerous water powers which are scattered broadcast throughout the length and breadth of this Dominion. Small towns particularly would be very much improved if the water powers within a reasonable distance could be utilized. There are many points which it is almost impossible to take up and discuss this afternoon. I would like to have it stand over for a year, so that we could have time to study it. I have no doubt that Mr. Magie has spent a great many hours in preparing this paper for us. It covers a great deal of ground and covers it well. I should also like to ask what the paragraph means on page 3, wherein he says, "that when electrically transmitted power does not cost more than $100 to $140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed." Does that mean where it costs users $100 to $140 per h.p. per annum?

Mr. Magie: That is intended to mean the cost of the installation, including the hydraulic and electric as well as the transmission portion of the plant. Of course, there are many cases where it would be very much higher.

Mr. Wickens: I think that this is a valuable paper, and it is a pity that we did not have it in hand a little earlier. It is too big a question to take up in an offhand way. There is no doubt there are many points in favor of the use of steam, and perhaps, by leaving the matter open and giving the gentlemen an opportunity to follow these up, we can show some very good results. This Association represents all parts of the Dominion, and there are miles of country that cannot be covered by long distance transmission from water powers. In those places we have to stick to the steam plant, and sometimes we manage to crowd the hydraulic plant very close, simply because it takes a large amount of capital to develop the water power. We have had a few illustrations. Take the Cataract power at Niagara. We know they are selling power in Buffalo, but nobody knows what it is costing. We know they have a great deal of money sunk in the ground, and are selling some current to Buffalo. I know that if we had a good steam plant, properly managed, at Buffalo, we would make money with it, and there are many others too far away from water powers to have this power reach at all, and there are more that have to be carefully managed by the engineer or they would not pay. For these reasons it would be an advantage if the paper was carried over, and thus give the members a chance to go and look into the matter carefully. It would be better to have it thoroughly threshed out, rather than have no discussion at all. I honestly hope that some arrangement will be made by which we can take this matter up at some other time. I hardly see that we can make much out of it at this convention. The balance of our time will be well occupied, but if carried over until the next convention, some of the members could give us some more good ideas on these lines.

Mr. J. J. Wright: I don't exactly understand the carrying over of this discussion till the next convention. It would be in the province of the gentlemen who would do that to bring in some new facts, but it also appears to me that the men who have been speaking on behalf of the steam plant do not appear to be as sure of the figures in connection with it as the electrical men are. I am quite prepared to endorse one paragraph in Mr. Magie's paper, which is the one referring to direct driven and belt driven plants. I think Mr. Magie has hit the nail on the head in this connection.

Mr. Reesor: I think we should dispose of the paper at this session. Its postponement may lead to accumulation at our next convention. Some questions might be got out of this that might lead to others next year, and perhaps leave it to some other wise head to get up a paper as a growth out of this one.

The President: I think we had better go on discussing the paper.

Mr. Magie: In preparing my paper I did not attempt to fight the steam man, and in fact, tried to give him good lee-way, but merely took up the electrical part of it. If it was wanted to fight the steam man, it would be better to get up another paper.

Mr. J. J. Wright: Most electrical investors won't admit that the steam engine is in the same category as the electric power.

Mr. Thompson: In suggesting that this discussion be carried forward, I do so purely from a desire that it would allow of a proper discussion of the paper. I think we all agree with Mr. Magie when he makes the statement that the use of direct current apparatus for high potential and long distance transmission is out of the question, and we also agree with him when he says the original installation per h.p. of from $100 to $140 can be made to pay. In fact, if I were writing the paper, I should have said $200, and then have stated that it could have been made to pay very easily, but the point arises, why put in 20,000, 30,000 or 40,000 h.p. plants, or, as Mr. Wickens points out at Niagara Falls, with an unlimited power, and then only be able to find customers for one-tenth or less of the output. Too many people imagine, as Mr. Magie has pointed out, that because the water fall, as we have styled it, turns the water wheel the power costs nothing. Mr. McFarlane very aptly illustrated this a short time ago in a little story, which I can hardly repeat in Mr. McFarlane's manner and therefore won't attempt it. The substance of it was this, that in a small town they had lights at a few cents a week, and power did not cost anything, because it was water power. A few years later the dam at the water power had broken down; operation of the plant was discontinued, and the people in the town returned to coal oil, as it was stated that "it cost too much to run water powers." But to come to the point, where large experiments have been attempted, an immense amount of money has been sunk in getting power in advance of the demand. With a city like Montreal I think it advantageous both to the company and to the city, because with the shipping facilities we have in Montreal and the large country to draw from, many manufacturing concerns will be induced to come to Montreal and establish their business so as to get cheap power, but that does not apply in every case. A few years ago I was working a few miles west of Toronto and there was a small town of 4,000 or 5,000 inhabitants wanting to get electric light. There was no way to get it according to advice from electric light companies unless they utilized a water power 10 miles distant. They put in a Thomson-Houston arc machine and endeavored to run from it at the same time both arc and incandescent lights. This was very unsatisfactory, and they then installed an alternating current machine, and still the company is not able to keep its head above water, simply because the cost of installation and keeping transmission lines in repair prevented that company from earning any dividend on their capital, while if they had installed their plant in conjunction with some other manufacturing business in the town, I think it very probable that the shareholders, with the assistance of the steam plant, would have made money. They have been for 15 years increasing their capital and receiving no dividends. This is a case where water power does not pay. Towards the last of Mr. Magie's paper he speaks of the general utilization of electric motive power in manufacturing establishments. I thoroughly believe in that. In 1895 it was my privilege to take a short holiday and go over the greater part of England. I spent six weeks there, and went into an establishment covering 60 acres, and where as a boy I served my apprenticeship. I remember that at that time there was a great big engine in one corner, with shafting, belting, etc., and I found that every shop in that establishment had now an independent steam engine. The consequence was that the power was only costing them about half what it did fifteen years ago, and this saving was not due to improved engines, but simply to the doing away with a lot of useless power. They can now run any part of the factory independent of the other parts, and I think every engineer will agree that this is the most economical way of running, and one that the shareholders will derive benefit from.

Mr. Reesor: I move a very cordial vote of thanks to Mr. Magie for his interesting paper.

Mr. Kammerer: I would like to second that, and while doing so I want to say to the steam engine and boiler men, that next year, if we go to Hamilton, as I hope we will, we will have a still harder nut for them to crack. Mr. Magie's paper speaks of what we expect to realize there, and I hope in a year from now the Cataract Power Co., of Hamilton, will have realized all that they expect to.

Mr. W. T. Bonner then read his paper entitled, "The Unconscious Ownership of an Important Key." (See page 145.)

DISCUSSION.

Mr. Browne: The title of this paper Mr. Bonner insinuated is a conundrum—to know what this key is. I don't know whether I have got it correctly or not, but I take it to be a suggestion to electric and also to steam roads to employ their rails for the transmission of wagon packages in their original packages, to avoid, besides the long haul by horses and the consequent labor, the cost of loading and unloading, perhaps from the near-by farm to the station, and putting it into a freight car and carting it away. And the unconscious ownership of the key is, that having the road-bed and perhaps the power in the shape of a fully and properly developed water fall, that they would be able to provide additional revenue to the investment, and also make unnecessary the aggregation of people in large cities, because with his proposed scheme the aggregation of population in large cities would not be necessary. People could conveniently live away from towns and large cities and carry on their business; and in this direction I may refer again to the possible changes in our civilization due to a system of this kind with the electric development of water falls. It seems to me the time is not far distant when, instead of gathering together in large cities, by the ability to utilize power in small quantities, requiring the investment of capital to a limited extent, that we may probably change our conditions and become more widespread. Small towns will be able to compete in manufacturing, because so much capital will not be required, and in that way I can see a great deal of advantage in the suggestions thrown out by Mr. Bonner that the production of these small places can be transshipped to places of consumption at very low rates, and in this connection I think his paper deserves a great deal of consideration from the owners of railroads and electrical enterprises.

Mr. Geo. Hill: While there is no doubt that this scheme of Mr. Bonner's is a very interesting one, I think that there is sufficient in it for question. He has struck one of the keys to success of suburban roads. I may say that there are other points of considerable interest that may be brought out by this paper that might be valuable to suburban road owners. His claim is largely to do away with the matter in hand, whatever the section of the country through which the road is to pass has to deal with. Certainly the scheme seems beautiful up to the point where the cart or truck is side-tracked and left there while the wagon is being taken away and returned. This means the lying idle of a certain amount of the rolling stock of the road, and while another portion of it (allowing that the wagon belongs to the railroad) is in use, nevertheless it is a question whether the former could not more satisfactorily bring his supplies down to a central distributing point opposite his or a number of farms, where it could be gathered up by a moving train at a certain hour, than could be done under the present system. If these wagons were allowed to remain uncovered as they are, the farmer's products would be exposed to the inclemencies of the weather as well as the fact that prowlers might get in at them. Then, again, he loses ownership of the material the moment it leaves the yard in trust of the syndicate. This would not satisfy the farmer, and he never would be satisfied until he followed the goods to market and got the very last cent that there is possible out of it, which as a business man he is entitled to. Now, the railroad company is not going to do this work of commission agent for nothing, and it is questionable whether the farmer wants to pay a commission. I have in my wanderings around the country come across quite a number of suburban roads, and some of them and their schemes are very interesting, noticeably that of the Hamilton, Grimsby & Beamsville road, where they seem to have a very excellent system that appears to be giving first-class results as far as they go. But there appears to be a lack of that broad-mindedness of purpose which we find not only in electric street railroads, but also, I regret to say, in electric light companies. They run through a most fertile country (using the Grimsby road as an illustration), tenanted almost entirely by large fruit-growers and farmers, each of which has a certain amount of power in use almost every hour of the day. They have the grinding of the ensilage product, threshing, pumping, churning, and everything of this nature going on, which requires a certain amount of power all the time, and yet, strange to say, none of these suburban roads seem to be willing to do anything in the way of allowing the farmer to take any power from their circuits. The key to the suburban railroad may be in this, but it seems to me that the suburban railway manager is losing sight of a large field of steady utilization of his power, through not canvassing the farmer and getting hold of that power that is being used all the time. In Manitoba and the Northwest Territories I know of a scheme that went so far that it had very careful attention—and some engineers figured the thing out that the farmer in Manitoba, on the large grain fields there, could, with the straw that they annually burn up in heaps every fall, do all the work of his farm that now requires from 100 to 150 teams, according to the size of the farm, by electric power, by centralising his power in one spot, drawing his straw after the season was over and keeping it in spots where it could be used from time to time; he would have sufficient power to do the farm work and do away with this large number of teams, to say nothing of the men to look after them. I trust you will excuse me; being a city hand I should hardly take the floor in convention, but I would like to say to suburban road managers that I wish to illustrate and throw open some new lines for supplying both power and light.

Mr. Hunt: I would like to ask Mr. Bonner if there is a place in Ohio where the system explained by him is in operation.

Mr. Bonner: These photographs were taken at Toledo, Ohio, where they have already built and are now using this system in an experimental way.

Mr. Hunt: The reason I ask is because I myself and some others have a charter for a road running out of London, and something like this would suit us very well.

Mr. J. J. Wright: I don't believe there is a farmer living who would pay one cent to have any work done that his hired man could do.

Mr. Magie: A large electric light company in Philadelphia is selling a good deal of power to be used for driving small pumps, etc., on farms.

Mr. J. J. Wright: I think in some special cases this might be done, but on the ordinary every day farm of commerce I don't think an electric plant could be put in to run it.

Mr. Hill: That is the kind of remarks we have been looking for during this convention; this is a direct challenge of my remarks. I would like to ask Mr. Wright if he knows of any class of people to-day who employ a greater amount of complex machinery than the farmer of to-day, and if at the same time he knows of any class of people who have to deal with more complex methods than the farmer. The farmer to-day, if he was as broad-minded as the individual who would get up and claim he would not pay ten cents if he could get someone else to do it, would certainly not have brought up his farm to any position where it could stand in competition with the large farms that are scientifically run. I know for a fact of a large number of farms around this mountain where much current could be used, running from 15 to 20 h.p., if the managers of the suburban roads would offer their power to them, and if the power could be had it would make no difference to the farmer whether he had to pay for it or pay the hired man to do it.

Mr. A. A. Wright: In the town of Renfrew we have had under contemplation the utilization of a water power which has been lying idle for years, and when we bring that into use we contemplate putting in motors and selling power. Four farmers living quite a distance from the town have made application for power, and have stated that if we would put in the wires they would furnish the poles and put them up and take the power. You must understand that the methods of farming are changing continually. The production of corn is one of the most important, and this has to be cut during the winter, when if they had a motor it would prove very handy to them. If the power could be given to the farmer he would take it, and could use it often.

Mr. C. H. Wright: On the Montreal belt line we have been supplying power to the farmers and have had more demand than we could supply. Our only trouble has been with the insurance people, who object to the "grounding." As regards the supplying of light from our circuit we have been unable to do it, even at our own hotel, where we have had to put in acetylene gas. Another matter in this paper is the transportation of farmers' produce—this can very easily be taken to the city, but when it gets there the farmer wants to look after it himself.

Mr. J. J. Wright: If anyone can give me an instance of any suburban road refusing to sell current, I will take back what I have said.

Representative of the Montreal Park & Island Railway: We have refused to furnish current, although offered a fair price for it.

Mr. Hill: Last March I visited a relative of mine just west of Hamilton, who has rather a nice place, and he told me he was patiently waiting for the Cataract Power Company's pole line to come through his section, because he had been repeatedly to the authorities of the Hamilton, Grimsby and Beamsville road, whose line was not further than a few hundred feet from his place, and although he was prepared to pay them from $40 to $50 per horse power per annum, they refused to supply him.

Mr. A. A. Wright: Mr. Leach, a Scotchman and a bachelor, lives about two miles from Renfrew, and has had his house all wired up and offers to put up the poles at his own expense. He has not yet got the light, but perhaps he will.

Mr. Thompson: I heard a gentleman say that the Park & Island Company refused to give power to himself and others, and very justly so. When he went to Mr. Holgate he said what he could give him was not at all what he wanted, for the reason that they are simply running street railway generators, and oftentimes the line opens. Now, what would be the effect of having a motor on a circuit like that?

Mr. J. J. Wright: As to the Grimsby instance, I think the difficulty is in the price—$40 to $50 is not enough for a "farmer's" horse power. I think you will find in the majority of cases the people are not willing to pay a decent price—they have the idea that this electric power does not cost anything, and they ought to get it for nothing. Why, even in the city of Toronto they are always howling for "cheap power," and if they could, would like to get it for nothing. In cases of friction between purchasers and consumers it is nearly always a case of friction as to cost. People keep telling them that this power will not cost anything, and that the millenium will be here right away, and he thinks he can churn the milk, rock the cradle and pull the cat's tail with electric power. When a man is told he cannot get the current for almost nothing there is a row and a kick.

Mr. Browne: I am reminded by what Mr. Wright says of something that I saw published a short time ago, which goes to emphasize his idea. There is a town in Canada considering the putting in of an electric plant to be driven by water power, and they have actually advertised that they will have power for sale in units of 30 h. p. and up, as low as $15 per horse power. If the project be carried through, and they be able to sell at $15 per h. p., it would seem to me to be very unwise for that town to undertake to transmit that current for 16 or 17 miles, when they could pick up the farmers before they got to the end of the 17 miles and make more money. I think the difficulty with railroads in seeking this market heretofore is that they have been built to meet the first demands, and have grown slowly, and have not therefore had the power to spare, because there are peak hours of the day for railroads, when the demand is more than they can supply, and they are not in a position to say to the farmer that at that time he can use the power. But electricity is only in its infancy, and, as Mr. Wright says, people are crying for electric current although some still cling to the tallow candle. The progress is onward, and the day is not very far off when all the farmers will be operating their farms, rocking their cradles, churning the milk and pulling their cat's tail by means of electric current.

Mr. Hill: I move a vote of thanks to the gentleman who gave us this paper, which has afforded such a pleasant discussion.

Mr. Ellis: I second the motion.

The President: Mr. Bonner, I wish to thank you for the interesting way in which you have prepared this paper, and also Mr. Browne for his clear explanation as to the meaning of the unconscious ownership of the key referred to.

Mr. Bonner: I would like to make one or two suggestions with regard to the doubt expressed by Mr. Hill of the farmer trusting his produce into the hands of the railroad company. As is stated on page 6 of the paper, the wagons will be tarpaulin covered at all times, whether loaded or not. Now, it is just as feasible to protect the goods in that way as any other, as they are transported on the English roads in this manner right along; in fact, I don't think I saw any box cars on the other side, and there is ample protection given to the goods by the tarpaulin cover referred to, which is attached by a chain running through eyelets on the edge of the tarpaulin and connected to the sides of the cart, so that it can be locked or sealed just as securely as if the shipment was in a box car. As to the farmer being unwilling to let his goods go out of his possession until they are turned over to the purchaser and he gets his money, I think this is largely a question of education; and as to the question of cost, I understand it to be one of the claims made by the rail wagon company, that they can effect this transportation cheaper by doing away entirely with the re-loading. In that way they will reduce the net cost of transportation from the farm to the consumer, and I believe that eventually this will be recognized as a fact.

The meeting was then adjourned until the following day.

SECOND DAY.

The President called on the Secretary-Treasurer to read his report for the year ending May 31st, 1898, which was as follows:

SECRETARY-TREASURER'S REPORT.

MR. PRESIDENT AND GENTLEMEN:

I have the honor to submit for your information and consideration the following particulars regarding the work of the Association for the year ending May 31st last, together with a statement showing the present standing of the membership and finances.

The Executive Committee have held five meetings since last convention. At the first of these held on June 20th, 1897, accounts amounting to $300.22 were passed for payment. Messrs. Kammerer and Armstrong were appointed a committee to learn what transportation rates could be secured for this convention.

At a meeting on September 7th these gentlemen reported that the railway authorities had promised to take the matter up after the first of the new year. A Committee on Transportation was then appointed, consisting of Messrs. J. A. Kammerer, C. B. Hunt, J. J. Wright, Wilfred Phillips and F. C. Armstrong. Messrs. C. B. Hunt, A. M. Bowman, A. A. Dion, J. J. Wright, A. M. Wickens, W. H. Browne and the Secretary were appointed a Committee on Papers. The following gentlemen were appointed a Committee on Arrangements, with power to add to their number and appoint sub-committees: Messrs. Wm. Thompson, W. H. Browne, John Carroll, L. B. McFarlane, F. H. Badger, jr., J. A. Baylis and O. Higman. The Secretary was instructed to render accounts to members in arrears for fees and make drafts if amounts were not paid within a reasonable time.

On April 5th, 1898, the Committee on Papers reported that offers of several papers had been received. It was decided that the completion of arrangements for papers should be left in the hands of the Secretary. Mr. Browne was authorized to engage a local stenographer to report verbatim the proceedings of this convention. Owing to Mr. Kammerer's illness Mr. Browne was appointed chairman of the Committee on Transportation. The dates recommended by the Committee on Arrangements were adopted for the present convention, and the sum of $150 was appropriated to the committee for entertainment purposes. The draft programme for the convention submitted by the committee was adopted with slight amendments.

At the meeting on May 25th nine persons were elected to membership and the resignations of ten members accepted. Mr. Kammerer and the Secretary were appointed a committe to obtain designs and estimates of cost for an Association button to take the place of the badges worn by members at previous conventions. The Secretary was directed to write members who had failed to pay the drafts made on them for arrears of fees that unless payment should be made prior to June 10th their names would be dropped from the membership roll.

In the early part of this year a pamphlet setting forth the character and purposes of the Association was prepared and printed under the direction of the Executive. About eight hundred copies of this pamphlet have been judiciously distributed.

Particulars of the important work which has engaged the attention of the Legislation Committee will be laid before the Association in the report which the committee will present at this meeting.

In view of the unusually full programme of events, it was deemed advisable to reduce the number of papers to be presented at this convention, but they are believed to be of a standard which entitles them to careful consideration and discussion, and places the Association under obligation to the kindness of the authors.

Incidental reference may be made to the recent formation of the Maritime Electrical Association (of which Mr. Bowman, a member of the Executive of this Association and author of one of the valuable papers on the programme of this meeting, is the president) to conserve and promote electrical interests in the provinces of Nova Scotia and New Brunswick.

During last year death again entered the ranks of our members, and we are called on to deplore the loss of Mr. Ross McKenzie, of Toronto, and Mr. Chas. Ernst, of Detroit.

During the year there was dropped from the roll the names of 21 members, 12 active and 3 associate members having resigned, 2 having died and 4 having changed their place of residence and having neglected to furnish their new addresses to the Secretary. Since the 1st inst. two additional resignations have been received, and the names of 13 members have been struck off the roll for non-payment of fees. Thus there have been removed from the membership list between last convention and this 36 names. During the same period there were added 68 active and 11 associate members—a total of 79 leaving the present total membership 234.

Following is a detailed statement of the receipts and disbursements for the year:

FINANCIAL REPORT FROM JUNE 1ST, 1897, TO 31ST MAY, 1898.

RECEIPTS.

Cash in bank, June 1st, 1897	$410.57	
Cash on hand, June 1st, 1897	5.25	
111 active members' fees at $3.00	333.00	
1 active member's fee at $3.00—paid	2.00	
20 associate members' feet at $2.00	40.00	
		$790.82

DISBURSEMENTS.

Expenses of convention		$351.77
S. Barnett's account	$150.00	
W. Phillips, band and floral decorations	34.00	
Transportation B. and N. F. electric railway	12.00	
Hotel Lafayette (cartage and express charges)	1.25	
Blackhall & Co. (100 certificate covers)	8.00	
Alexander & Cable (lithographing badges)	5.00	
George Angus, stenographer	25.00	
Electrical News, printing	111.79	
Pins and ribbon for badges	3.18	
Express charges	1.30	
Telegrams	.25	
	$351 77	
Grant to Secretary	75.00	
Electrical News, printing account	24.00	
Stationary and carbon paper	5.55	
Printing 150 certificates for members	1.25	
Exchange on cheques and drafts	7.20	
Express charges	.64	
Postage	24.77	
Cash in bank, May 31st, 1898	281.18	
Cash on hand	19.46	
		$790.82

RECEIPTS SINCE MAY 31ST, 1898.

Cash on hand, June 1st, 1898	$ 19.46	
46 active members' fees at $3.00	138.00	
1 active member's fee for one year and eight months	5.00	
5 associate members' fees at $2.00	10.00	
		$172.46

EXPENDITURE.

Postage	22.65	
Exchange on cheques	1.10	
Receipt forms	.30	
Telegrams	1.43	
Express and duty	.41	
	$ 25.89	
Cash deposited in bank since June 1st, 1898	113.00	
Cash on hand June 25th, 1898	33.57	
		$172.46
Total standing to credit of Association, June 25th, 1898	$427.75	
Receipts since June 25th	$161.00	
Total at credit of Association, June 29	588.75	

On motion of Mr. Barrie, seconded by Mr. Breithaupt, the report was adopted.

The next item of business was the consideration of the reports of committees. The President advised that the only one that had been written out was the report of the Committee on Legislation, of which he was the chairman, and which was as follows:

REPORT OF COMMITTEE ON LEGISLATION.

Your Committee beg leave to report that in pursuance of the motion passed at the last Convention held at Niagara Falls, instructing your Committee to take up the matter of securing legislation in connection with the movement among municipalities in Ontario to enter upon electric light undertakings, in unfair competition with companies already in existence, your Committee held their first meeting at the close of the Convention. At that meeting it was decided to procure an opinion from Donald Guthrie, Q. C., ex-M.P.P., of Guelph, and to retain him professionally on behalf of the Electrical Association in connection with the question.

Various questions were submitted to Mr. Guthrie, and his opinion in answer to these questions was considered at a meeting of your Committee held in Toronto on the 9th of November. A copy of the opinion is attached to this report.

We also had a communication from him, giving his views as to the prospects of securing favorable legislation at the last session of the Legislative Assembly. After full discussion your Committee decided to give instructions for the preparation of a short bill to be submitted to the House, which would at least afford some measure of relief to those companies that were immediately threatened with unjust municipal competition.

Another meeting of your Committee was held in Toronto on the 10th of December, when the solicitor was present, and after considering the whole situation fully and carefully, instructions were given for further proceedings.

With that view a bill was prepared which came before the Municipal Committee of the Legislative Assembly on the 12th of January. Your Committee, in preparation for the meeting, assembled in Toronto on the 11th and also on the 12th, and attended the meeting of the Municipal Committee for the purpose of supporting the bill. The Committee had also the assistance of Mr. Lash, Q.C., with Mr. Guthrie.

After discussion those representing us consented to a suggestion of the Honorable Mr. Hardy, Chairman of the Municipal Committee, and other members of that Committee, to allow the matter to stand over for another year. The discussion, however, brought out the fact that there was really no sound answer to the principle of the proposed measure. It also evoked an expression of opinion from the leading men of both political parties to the effect that the underlying principle of the bill was just. The Municipal Committee thought that there was not proper time to consider how the bill would affect places where there were more than one existing plant, also places that derived or may derive power from points outside the municipality, also to consider the length of the life of an electric plant and other questions, and in the judgment of the Municipal Committee any bill dealing with the matter would require more ample public discussion and some modification. The action of your Committee and the discussion the question has received has tended to bring into prominence the injustice of the present law. The necessity and propriety of some measure of relief may be considered now to be more generally admitted. The work thus inaugurated and which has attained a hopeful position, should not be discontinued.

The present law of Ontario is inequitable towards lighting and power companies, because it permits a municipality, after it has given its sanction to the formation of such a company and has encouraged enterprising citizens to embark their capital in it for the purpose of supplying the municipality with light and power, to turn around and destroy, with public funds, and without public necessity or advantage, the value of the property of those citizens who were encouraged to invest their private means in the enterprise. What evidently struck the majority of the members of the Municipal Committee was that the proposed legislation was just and equitable because, while it did not prevent municipalities entering upon municipal supply of lighting if they so desired, it made provision for extending the existing law regarding water works to the case of lighting companies. This law is to the effect that where a municipality desires to supply water and there is an existing water company incorporated for the municipality, the council shall not levy any water rate until the council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of the Municipal Act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfaction of the company; the price to be determined by arbitration under the provisions of the Mnnicipal Act.

It will be observed that this provision in no way interferes with municipalities going into the supply of water. It simply provides that if they do enter upon such undertaking they are by this law bound first to try to buy at a fair price, or at a price to be fixed by arbitration, existing waterworks. No good reason can be advanced why this law should not be extended to lighting and power companies as well as to waterworks. It is eminently just, and it imposes no hardships on the municipalities; nay, rather, it benefits them, because it tends to extinguish rivalry to themselves, which rivalry might render municipal operation of these works unprofitable, and at all events it puts them in possession, at a fair valuation, of the very plant and material that they would have to purchase from other people if they are going into the business. The proposed legislation is in the public interest, because it will further encourage private citizens to invest their capital in extending and improving existing lighting and power works.

It was generally acknowledged by the Municipal Committee that electric light companies as well as water companies have always come into existence with the consent, encouragement and approval of the municipality, which has granted the use of the streets, etc., for these works.

The last meeting of your Committee was held in Toronto on February 3rd, for the purpose of passing accounts. At this meeting, accounts for legal services, printing, stationary, postage, exchange on drafts and office assistance, amounting to $622.56, were ordered to be paid. The funds to meet this amount were contributed by the following companies: Brockville, St. Thomas, London, Ottawa, Waterloo, Brantford, Carlton Place, Guelph, Lindsay, Galt, Barrie, Owen Sound, Cornwall, Strathroy and Cobourg Gas Company, in amounts ranging from $150 to $10. It will be observed that while there are about two hundred lighting companies (who were all invited to assist) carrying on business in the province of Ontario, all more or less interested in having legislation secured to protect their capital from confiscation, only fifteen of that number contributed to the expense fund of your Committee. We are pleased, however, to say that through the liberality of these companies all claims are paid. It is quite evident to your Committee that if the work in hand is to be carried to a successful issue, a more general, liberal and hearty support will have to be accorded them. It ought to be mentioned here that all the members of your Committee paid their own travelling and other expenses in connection with attending the meetings. The movement amongst municipal corporations to enter into the lighting and power business in competition with those who had the courage to be pioneers is growing, and unless regulated in some way by the legislature, will result in the confiscation of a large amount of capital invested in the business, as witness the town of Barrie now preparing to put in a complete plant, including arc, incandescent and power services, to be paid for out of public funds, for the purpose of competing with and destroying the Barrie Company, a private and lawful enterprise.

Your Committee desire to mention that Mr. Pepler, Q.C., of Barrie, and Mr. Farley, Q.C., of St. Thomas, two of the members of your Committee, rendered valuable services in connection with the promoting of the bill referred to.

Dated 14th June, 1898.

JOHN YULE,
Chairman of Legislation Committee.

GUELPH, 4th November, 1897.

JOHN YULE, Esq.,
President Canadian Electrical Association, Guelph.

DEAR SIR,—In answer to the questions submitted by you for my opinion, I have to say:

By the statues now in force in Ontario touching the acquisition of gas and electric works by municipalities, municipal corporations have the power: (1) To erect gas and electric works and operate the same in opposition to an existing gas and electric light company, without the consent of that company and without attempting to negotiate with that company either for the supply of light or for the purchase of their works, and this notwithstanding the fact that the company might have been organized and carried on with the express sanction of the municipal council. (2) Municipal councils have also power to acquire the rights of a gas company incorporated on and after the tenth of March, 1882, at a valuation, that is to say, they have power to expropriate the property, and they, of course, also have power to acquire it by agreement with the company. (3) On the other hand, it appears that a gas company or an electric light company has no power to prevent a municipality entering into competition with them in the case of gas and electric works or to do anything which shall compel the municipality to purchase their works at a fair valuation.

In regard to the powers of a municipality to construct water works, there seems to be a restriction which does not exist in the case of gas and electric light works, for, by section 507 of the Consolidated Municipal Act (1892), it is provided that in case there is any water company incorporated for the municipality, the council shall not levy any water rate until such council has, by by-law, fixed a price to offer for the works or stock of the company, nor until after thirty days have elapsed after notice of such price has been communicated to the company, without the company having accepted the same or having, under the provisions of that act as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid or has been secured to the satisfacion of the company. By 60 Vic. (897) Chap. 17, Schedule C 88, it is further provided that the price shall be determined by arbitration under the provisions of the Municipal Act.

It seems to me that an amendment to section 507 should be sought, making it to read that in case there is any gas company or electric light company or water company incorporated or existing in the municipality, the council shall not levy any rate for the construction of gas or electric light or waterworks until the council has, by by-law, fixed a price to offer for the works or stock of the company, etc. That would place gas and electric light companies on the same footing with water companies.

There is no just or sound reason why Parliament should refuse an amendment to the Municipal Act to give gas companies and electric light companies the same protection as water companies, against municipal interference with an existing business, and subject to provisions for an arbitration. I think such an amendment would be likely to carry. It couldn't be said that its effect would be to prevent municipalities from embarking in municipal lighting. They would still retain full power to do so; but to do so with the plant and works of an existing company, to be first acquired on fair terms.

In case a point was made in this connection, that municipalities should have the power of erecting their own lighting plants without being compelled to purchase the commercial part of a plant of a gas or electric light company, provision could be made for such a case by an enactment compelling a gas or electric light company to sell the part of their works connected with public lighting in case the Lieutenant-Governor-in-Council, or arbitrators to be named by him, considered they ought to be compelled to sell the same to a municipality without requiring the municipality to purchase the part of the works of the company connected with commercial lighting.

In order to secure an impartial judicial investigation and decision on the important questions involved, I suggest that the arbitrators, under all the amendments herein suggested, should be three county judges to be named by the Lieutenant-Governor-in-Council, they to determine as to right to purchase and the extent and price and terms and conditions of purchase.

I may also suggest for your consideration, whether it would not be expedient to consent to a provision for an arbitration to fix the rate for public street lighting which a municipality should pay to an existing company in case the municipality and the company differed. In that case a municipality would be deprived of an excuse for going into gas or electric lighting on its own account.

In England local, in other words, municipal authorities, are only authorized to supply gas for public and private purposes throughout the whole or any part of their district where there is not any company or person authorized by or in pursuance of any act of Parliament or any order confirmed by Parliament to supply gas for public and private purposes, and where such company or person do not supply gas within any part of the district covered by the local authority, and if there is any such company or person so supplying gas, but the limits of supply of such company or person include only part of the district, then the local authority may themselves undertake to supply gas throughout any part of the district not included within such limits of supply, but even then before the local authority may, under the act, themselves undertake to supply gas for the whole or any part of their district, they must obtain a provisional order authorizing a gas undertaking under and subject to the "Gas and Waterworks Facilities Act, 1890"; that is, they have to obtain authority from what, in England, is known as the Local Government Board, which has been, for the purpose of that act, substituted for the Board of Trade. There is also in England provision giving gas companies power to sell their works to local authorities, that is, by mutual agreement.

The law in Scotland is regulated by the Burghs Gas Supply (Scotland) Act, 1876, but the first provision of that act limits its application so that Burghs have no power to supply gas within any part of the area of supply over which any gas company incorporated by Act of Parliament or any co-partnership or person authorized by any provisional order confirmed by Act of Parliament, shall have statutory powers to supply gas at the date of the adoption of the Act in the Burgh.

The Commissioners, under this Scotch Act, for the Borough, however, are authorized to buy from gas companies (that is, by mutual agreement) their works; but there is also a special provision to which I desire to call your attention: Section 21 of the Act, that "Where there is a company not incorporated by Act of

Parliament or authorized by provisional order confirmed by Act of Parliament supplying gas within a Borough, the Commissioners, before they shall exercise any of the powers conferred by this Act, shall give notice to such company that they are willing to buy or to treat for the purchase of the undertaking of the company and of all the rights, powers and privileges and all the lands, premises, works and other property of the company, and if such company shall consent in manner provided by the last preceding section, to sell the same, the commissioners shall purchase the undertaking on terms mutually agreed upon or to be fixed by arbitration in the manner provided by the lands 'Clauses Consolidated (Scotland) Act 1845' respecting matters thereby directed to be settled by arbitration, and if such company shall refuse to sell the same, or shall not within two calendar months after the service of such notice return any answer, the Commissioners may present a petition to the sheriff stating the facts, and the sheriff shall, on being satisfied by evidence of the facts as stated, discern accordingly, and on such decree being announced, the Commissioners shall have and may exercise all the powers conferred by this Act"; a clause which seems to me to be substantially in its operation the same as our enactment, section 507 of the Consolidated Municipal Act with regard to water companies.

As quoted in your annual address to the Canadian Electrical Association in June last, section 27 of the British Electric Lighting Act, 1882, provides that where an electric light company is established the local authority or municipality cannot interfere with it until the expiration of twenty-one years or such shorter period as is specified in the application for the provisional order or in the special act, etc. At the end of twenty-one years the municipal authorities may, by notice in writing, require the electric light company to sell their undertaking upon terms specified; if they do not so require, then the company goes on for seven years further; at the end of that seven years the municipal authorities have again a right to purchase, and so on at the end of every seven years. Then it has to de observed that the terms of purchase include not only the value of the lands and works, but also, where part only of the undertaking is purchased, provision must be made for loss occasioned by severance.

With regard to the law in the United States, it is said in a work of Crosswell on the law relating to electricity: "If an electric light company exists in a town, and has been granted by the town certain rights to set its poles and string its wires over the city, yet if this right is not exclusive in terms the city violates no contract or debt towards the electric lighting company by purchasing its own (i.e., a rival) electric lighting plant and engaging in the electric light business. To avoid, however, the practical injustice of such a course, the statutes which authorize municipalities to engage in the electric lighting business generally provide in some way or other for the purchase by the municipality of any existing electric light plant at prices fixed by the commissioners in case of disagreement."

The same work states that in Iowa, Massachusetts, Michigan, Nebraska, Ohio and Pennsylvania, statutes have been passed regulating the subject of the operation of electric light plants by municipalities.

I would suggest that your general committee appoint an executive committee to attend to the whole subject of promoting and securing the necessary legislation, and that a short agreement be got from those gas and electric light companies who are willing to contribute towards the expense, in some such form as I now send.

Yours truly,
(Signed) DON. GUTHRIE.

Extract from Mr. Guthrie's opinion to Mr. Yule, President Canadian Electrical Association, 4th November, 1897:

"I therefore recommend that an amendment or amendments, as here indicated, be applied for, and that your Committee on Legislation should take the usual steps in such cases to promote the passing of the measure. This would include interviewing the leading members of Parliament, both on the Government and opposite side of the House; the circulation of printed matter, securing favorable articles in the leading newspapers, so far as possible; having the officers of the various lighting companies throughout the province interview their local members and secure their support as far as possible to the measure; also by counsel and otherwise to support the proposal when it comes before the municipal or other committee of the House to whom such bills are referred, and by other legitimate means have the adoption of the necessary amendment secured."

Mr. J. J. Wright moved that the report be received and the committee continued.

Mr. Hunt: In regard to this report, I think it has gone into the question so thoroughly that it has left nothing for the committee to add to it. I would like if some of the members, who are not on the committee, would express their opinion as to whether they approve of it or can devise some better way of handling the matter. I think some of the members who are not so conversant with it as the committee might give us their opinion.

Mr. Noxon: Those who were at the convention a year ago will probably remember the discussion which took place upon this subject of the adoption of municipal plants by municipalities before they were justified. I stated at that time that I was not directly interested in that question, having foreseen when entering into the electric light business a probability that a plant instituted by private enterprise might become worthless by competition from a municipal plant, but I am in thorough sympathy with those who have such opposition and may have their plant depreciate, and I think it only right that every effort should be made by those in the business to remedy such a state of affairs. I notice in reading over this paper that they have a law in Great Britain—Scotland I believe—such as we are seeking to obtain. This is one of the strongest points the Association can make, as throughout Canada and all English speaking countries the English law has been taken as a precedent, and I therefore have greater hope of accomplishing what we desire in that direction, because in addition to the justice of the position, the fact of a law having been passed in Britain, where they have had more experience probably than we have had in this country, should influence our legislators. I see it is said in this report that it is nothing more than just and right that a municipality should, before embarking in opposition to a private enterprise, be first compelled to take the position of coming to an amicable settlement covering the purchase of the existing plant. I see, however, that a parallel is drawn with the Water Works Act. It is quite possible that those who are promoting this directly and having to do with the legislators, will have the objection made that whereas a waterworks plant is one of permanency, not only in the nature of its construction but also in its general principles, it may not be considered, as a lawyer would say, "on all fours" with an electric light plant, which is liable to a great many changes necessitated by the constant improvements and inventions in the art. It might be said that the electric light plant might become obsolete by reason of later improvements and inventions, whereas a waterworks plant is not likely to be subject to that condition. I don't think, however, this would be a very important contention, because the law would fix the value of the plant as relating to the modern methods of construction and operation, and for that reason there would be no objection or injustice in insisting that whatever the nature of the plant might be, the municipality should be compelled to take it over at its value, considering the special features in the case; and I do not see that this Association can be accused of anything in the way of selfishness in endeavoring to legislate with that purpose and end. We will, of course, as an Association and as members, look at this matter from the other side as well as our own, as nothing can be gained by looking at anything from only a selfish standpoint. You cannot expect your ideas to prevail unless they will commend themselves to those whom you wish to convince, and for that reason we must look at the matter from other points of view. We have endeavored to do that, and I can see no reason whatever why the municipalities should not accept this, and why the government could not provide this legislation. I think the convention is perfectly justified in using its utmost endeavors and influence to bring this legislation about, and I believe that if this is done, by united efforts the legislation can be procured.

Mr. Breithaupt: I am not conservant with this subject, this being the first convention I have attended. I cannot, therefore, say much on the subject. As already brought out, the point of precedent having been set in England and Scotland seems to me to be about the strongest argument aside from the proposed legislation being just for both parties. If it is just for waterworks to have such legislation, why is it not equally just for gas and electric light companies? Taking the three on a par, I don't see why the municipalities should raise great objections, because they can, at any time, have an arbitration before purchasing the plant, and they would not, I presume, expect to pay for the plant less than its par value. In the United States, as is also brought out in the report, there is a similar act which also assists and helps to encourage the individual, corporation, gas and electric light companies. All of these facts together should certainly help the Association in getting this desired legislation. There is another point which certainly needs to be emphasized, and that is that those of us who are central station managers will certainly have to support the legislation, not only by speaking for it, but also financially. I realize that very clearly. There is a great deal of expense connected with it, and I think we all should do our part in helping to bear this expense. There are a few towns in the west who have had this question brought before them in a very emphatic manner. In our own town they still have some five weeks to decide whether they will bring the matter of lighting to vote, put in a plant, or give the present company a contract for a number of years. A lighting company in a neighboring town, whose manager is also present, have found a good deal more difficulty than we have, and they have the question brought even more emphatically before them than we have. The point brought out by Mr. Wright as to keeping on friendly terms with the members of the town council is a very good one. We endeavor to be so as much as possible, and if we cannot secure this legislation, we can at least continue supplying the town with light and power. I would very much like to see this legislation secured during the present year, and the various companies receive the protection that is really due them.

Mr. Ellis : I don't know that I can add anything to that which has already been said. I may tell you a little about our experience in Barrie. We have been for two years without a contract from the town. We have approached them in every imaginable way, and they simply say, "We don't intend to talk to you at all." About three weeks ago I wrote, asking if they intended renewing the contract, that we were anxious and willing to negotiate with them on a fair and reasonable basis, and put in another clause saying that if the town really desired to go into the electric lighting business, we would sell our plant at its value. In reply they wrote us to put in a tender, and, in fact, advertised broadcast for tenders, and asked to have ours put in with the rest. We thought it was unfair to bring us in competition with the manufacturer, as we had a plant that had cost a great deal of money, and no doubt more than it was worth to-day. We had established a business and built pole lines in all parts of the town. We wrote them to that effect, suggesting that we would be willing to have the value of our plant fixed by appraisement, they selecting one representative, we the other, and these two to select a third. But they would not listen to this at all. I know our Mayor has corresponded with the heads of municipalities regarding this matter to get their experience. We are going to have some very strong opposition. I think it is becoming of this Association that we start right in now, and not only talk about this legislation, but interest the members in our constituencies, and put every argument before them, so that they can see we are only asking what is just and right.

Mr. Noxon : I would like to suggest the advisability of discussing the question of the separation, in case of the purchase of the plant by municipalities, of the municipal and private service. In the event of separation I see a great deal of difficulty in the municipality buying only a portion of the plant. The report says it could be separated. I don't see how. It would practically mean the doing away of the private business of the company unless they put in a separate plant, and this, I think, complicates the matter very much and is a very important factor in the disposal of these plants in the event of purchase by municipalities.

The President : I have followed this matter closely, and am glad that others have spoken in the way they did, not only on the report, but on the financial aspect of the case, because my experience has been that the majority of people are always anxious to reap where others have sown. They give all sorts of promises, but when it comes to the point they are not there. What was impressed upon your committee at the last meeting of the legislature, was that these things have to be fairly and squarely met, and have also to be freely discussed. The committee of the legislature did not feel inclined to go on with the bill last session. The House was called two months earlier than usual, and being the last session of the House, members were not disposed to commit themselves. In place of submitting the regular bill a short bill was introduced that would give relief until the larger bill could be put through, and it was understood that if there was any opposition, the members should not be asked to commit themselves in any way. There are different ways of looking at the thing. One eminent counsel was so impressed with the fairness and justice of the proposed legislation that he said he would not be afraid to go into any constituency and defend the vote of any member. This gentleman went over to the great majority a few days ago—the late Mr. Dalton McCarthy. The ground was broken, however, and we have made, I think, very good progress. Hon. Mr. Hardy made the remark to us as we went out, that he had no doubt that in any question of this kind that might come up in the province during the year, the municipalities would be willing to submit the matter to arbitration, but we find in Barrie that they will not negotiate in any way. I have good hopes of getting a certain amount of protection from the legislature if gone about in the proper spirit and the arguments made in a fair and business like way, and I am sure the work done during the year will bear fruit and help us very considerably.

Mr. J. J. Wright : I think the strongest prominence should be given to the fact that when the plant is purchased by arbitration, it is purchased at its value. Every plant has its value, and the municipalities would only be asked to purchase the plant at its value, which would be the same to the municipality as to the lighting company. I think if that point were given greater prominence that a good deal of the objection would be disposed of. There is another serious objection, that is, the dividing of the two branches of private and commercial lighting. Now, if in some town a small plant was operating commercial and private lighting and the municipality desired to purchase only that part of the plant that they wanted, it would simply mean ruination for the company. The investment of the company would be practically destroyed, because it would leave them with a small dynamo or proportion of one that was used in the supply of commercial lights. This is a question that should be impressed upon the committee, so that they may give that point particular attention.

The President : I think in the English Electric Lighting Act they have a provision for severance.

Mr. J. J. Wright: I think if you go to the legislature and ask that the municipalities should be compelled to purchase the business of a going concern with the good will of the electric light business and the franchise of it, you will not have much success. The only way is to get the municipality to arbitrate and take over the whole business at its value. I know a great many people who, in considering this question, have the idea that it is poor policy for a municipality to go into commercial business, especially electric lighting and power. Why should the municipality go into the business of supplying power to a few users when the socialistic problems of municipal affairs are of much greater importance? For instance, they could go into the coal business, which is a necessity, and let the people have coal at cost prices ; also the supplying of bread and other necessities.

Mr. Ellis : Is there a precedent in Canada of any municipality entering into opposition with any company for commercial and street lighting? I ask this because I was reading an article not long ago, which gave the opinion of the Chief Justice of the United States. This matter had been brought up in the courts, and he gave the decision that the demands of the people made it necessary to establish such enterprise, and municipalities encouraged private citizens to invest their money therein, and he said that while it might not be giving them a perpetual franchise, it was in reality the same thing, and he said that that kind of confiscation of the people's money should not be tolerated, and the law must step in and protect the investors.

The President : You will all doubtless remember that some time ago in Toronto, Baron McDonald proposed that the charter of the Street Railway Co. there be cancelled, and the mayor very quickly stepped in with a report and pointed out the unfairness of cancelling the charter of a company in which the innocent shareholders had placed their money, and that he was, therefore, not in sympathy with it. Why should they do this thing to electric light companies?

Mr. J. J. Wright: I cannot understand why the electric light industry should be singled out as an object of attack by the municipalities.

Mr. A. A. Wright: They think there is a lot of money in it.

Mr. Ellis: I had occasion, as Mr. Smith knows, to go into the court business myself, against one or two of the strongest corporations of Canada, and Justice Rose ruled against me on this account, that the corporation had invested a lot of money and had established a business, and it was not fair for me to go in there and demoralize their business, and he thus gave his decision against me. There was no precedent for it. I think perhaps if I had had the matter brought to the higher courts in Canada they would not have decided in our favor.

The President: From Messrs. McCarthy's and Guthrie's opinions it is very clear that the municipalities have the right to go into competition with the local company.

Mr. W. A. Johnson: There are both commercial and street lighting systems used in St. Marys, where the corporation have put in a street lighting plant and have not gone into the private lighting.

Mr. Breithaupt: The point was brought up why the lighting companies were attacked. I think it is just because of the popular vote, and that is why there is always such a howl made about lighting contracts before election—in order to get the vote.

The President: Another idea that some municipalities have is that if a dynamo is set alongside their water works it will light their streets for nothing.

Mr. Ellis: In connection with the Barrie waterworks they have two steam pumps, and two-thirds of the people of Barrie think, and some of the Council lead them to believe, that all they have to do is to hitch a dynamo to the pumps and they can run their street lights.

Mr. J. J. Wright: Why, that is what they think in Toronto.

Mr. Noxon: The question might arise as to how far the electrical supply men are responsible for this idea of municipal lighting. It occurred to me that if the supply men would not encourage municipalities in this thing, it would go a long way towards getting rid of the difficulty. I think it would be only just to ask that the supply men do not do any more than is necessary to encourage municipalities to put in plants of their own—not refuse to give them figures, but protect the legitimate trade by not giving inside information or prices.

Mr. Johnson: On behalf of the supply men, I wish to say that quite recently it was proposed to put a plant in a small town. Elaborate specifications were prepared by the engineers, but they had not any by-law authorizing the purchase of the plant or any money to pay for it. Certain of the supply men got together to consult about the advisability of offering some agreement that no manufacturing company should tender unless the municipality had fully decided to purchase a plant and had made arrangements concerning the funds necessary to pay for it. I think the feeling among the manufacturing companies was that it was a very desirable arrangement if it could be fixed in a workable manner. I might say that within three or four days after the suggestion to make such arrangement, the town councillors and pretty nearly everybody else had heard about it, which, of course, made it impossible to carry the proposition through.

Mr. Ellis: When tenders were called for in Barrie, they were to close on the 6th day of June. About the 5th or 6th they had very few tenders, and an untrue and malicious report was circulated broadcast that we had bought up all the supply men and manufacturers in the country; so they sent their engineers to nearly every place in Canada where they were manufacturing, and I understand they now have a bag full of tenders. In our case I think the supply men have not shown any tendency to encourage municipal ownership.

Mr. Hill: I trust the proprietors of electric light installations do not look upon the supply men as their enemies. I am sure if they look at them in the light they ought to, that the relations between them would be much improved. Take the question of the installation just spoken of. The gentleman said that it was imagined by those interested that this expert of theirs had bought up all the electrical people in the country, or possibly they had bought him up, but I think it would be necessary for him to do the former in order for him to carry out the specifications in the first place, as in order to carry out these specifications they would be doing an injustice to themselves and the town, and as such the result Mr. Johnson spoke about was brought about. The electrical supply men of Canada are working for the prosperity of the electrical people as a whole. We have brought out nine-tenths of the improvements in apparatus and supplies, from the incandescent lamp back to the dynamo; we are bound up in your interests, and any set-back that the electrical fraternity receive, either in a large or small degree, would be a set-back to ourselves, and I can assure you, from my experience of the supply dealers of Canada, that for you to imagine that we are going to cater to a trade that would hurt the electrical fraternity, would be a mistake.

The President: In regard to the supply men, we know who are our friends and who are our foes. We know a great deal more than they give us credit for sometimes.

Mr. J. J. Wright: That is all right, but there is another class doing more harm than the supply men, and that is a certain class of half-baked people, such as dynamo tenders and supply men, who pose as electrical engineers, and when they are fired out of some reputable concerns in the country, they go around stirring up lies.

Mr. Bowler: There are some people that that remark might hit pretty hard. I am running a municipal plant. I think Mr. Wright should name the parties to whom he refers.

The President: I don't deny for a moment that any municipality has a perfect right to go into the lighting business if they wish.

Mr. Browne: I believe, however, that it is not admitted that an electric light station already installed in a town or city can be attacked by the municipality investing in a plant to compete with it.

Mr. Reesor: I would like to draw your attention to this fact, that according to the Ontario Statutes municipalities, when they donate a bonus to any manufacturing concern coming to their town, must not interfere with existing interests of the same class of manufacturers. Now, the municipality, in putting in a new plant to do its lighting, is really using the taxes contributed by the private individuals who own the other plant, to purchase and sustain the opposition plant.

The President: There is another view, that is, the difference between the manufacturing and the electric light plant. If we were on the same basis as a manufacturing institution, and could move, we would not bother with the municipality, but we are tied down, and have capital invested which cannot be moved. We hear every day of offers being made to factories to move to other towns, but lighting companies do not have that advantage.

Mr. A. A. Wright: This is a very difficult subject to handle; there are so many interests at work. There are the political enemies and the aspirants to office which you have to deal with, and a certain class of people and a certain class of supply men. I know of one supply company that sent their best man into our town to work up an opposition plant, and they succeeded in doing it. I remember it and will remember it for a long time, but, fortunately for our town, I don't think there is much danger of their going into the electrical business, because they are involved in debt and cannot do it. However, I think they would be inclined to treat us fairly if they did. With reference to our keeping a sharp eye on the electrical supply men, I think we should do this, but still you must understand this is a very dangerous ground, for these men who are our opponents, by telling half the truth, will make the people believe that we have arranged with the supply men not to sell to municipalities either plants or supplies. So we have to be very careful what we say and do, but it is well to let the supply men know that although we don't do a great deal of talking, we do a lot of thinking, and although we don't ask that they tell the municipalities that they won't sell them a plant, still, at the same time, they should, in justice to themselves, because it is the electrical men who are going to buy their supplies, be very careful and throw all reasonable cold water on the scheme. I think we should make every exertion to secure that amount of legislation which will protect us from new plants. It seems to me that that is the place where our strongest defence should be, and that our energies should be earnestly devoted to this matter.

Mr. Hill : There is another phase of this question worthy of consideration. Mr. Wright has stated that we should watch the electric supply men. Now, the electric supply man is out for business pure and simple. I am speaking now of Canadian electrical supply men. If he can get the electrical business of Canada he is satisfied, but where the managers of certain companies come to the conclusion that all they have got to do is to go across the border to buy their plant and supplies, the electrical supply men think that the town in which his company operates is not one that is assisting home industries, and immediately attacks that town. We have got to patronize one another, and where we find we cannot approach the manager of electrical industries at present in Canada, we are bound to get into that town if we possibly can, and use our energies to secure that portion of the trade.

Mr. A. A. Wright : I don't think there are many owners of plants but that always give the preference to Canadian supply men, and I think that the majority of supply men treat us fairly. There are members of churches who are not very good Christians, and there are also members of the supply fraternity who are not good business men. Really, I think if the supply men would tell the whole truth it would be better.

Mr. Hill : We generally do that.

Mr. Johnson : There have been manufacturers who have made it a policy never to interfere with a local illuminating company in the way of starting a plant in the same town or inducing the municipality to go into the business, but on the other hand I can say that there are manufacturers who have done both of these things, and there have been other cases where the illuminating company's employees have gone so far as to instigate and encourage the starting of a municipal plant in another town, and have done it in the shape of a fee for the consulting engineer.

Moved by Mr. J. J. Wright, and unanimously resolved, that the report of the Legislative Committee be adopted, and that the Committee be continued as a part of this Association and instructed to prosecute the work.

Mr. Reesor, on behalf of the committee appointed to name standing committees for the ensuing year, reported as follows :

Committee on Statistics—J. A. Kammerer, Toronto ; A. A. Wright, Renfrew ; S. J. Parker, Owen Sound.

Committee on Meter Inspection — A. A. Dion, Ottawa ; E. E. Carey, St. Catharines ; J. J. Wright, Toronto.

Committee on Legislation—A. L. Breithaupt, Berlin ; C. Berkley Powell, Ottawa ; John Yule, Guelph ; C. B. Hunt, London ; B. F. Reesor, Lindsay ; J. J. Wright, Toronto ; W. H. Comstock, Brockville ; F. Pepler, Barrie.

This selection of committees was unanimously approved of.

The President : The next item is the deciding of the place of meeting for next year, and in that connection I have an invitation from the Cataract Power Company, of Hamilton, which I will read :

HAMILTON, Canada, June 25, 1898.

C. H. MORTIMER, ESQ.,
Sec'y Canadian Electrical Association, Montreal.

DEAR SIR,—The Cataract Power Company takes pleasure in extending to the Canadian Electrical Association its most cordial invitation to hold its next annual convention in the city of Hamilton.

We will by that time have some matters of modern electrical engineering, as well as the industrial applications of electric power, which would probably prove of interest to the members of the Association.

We trust that we shall have the opportunity of entertaining the members of the Association at their next meeting.

Yours truly,
THE CATARACT POWER CO. OF HAMILTON, LIMITED.
H. R. LEYDEN, General Manager.

After the reading of the invitation, Mr. Black, of Hamilton, said : I have been thinking for some time that we should go to Hamilton. I feel a little reluctant in moving that the convention go to Hamilton, following after Montreal. They have treated us so well here and promised us so much to come, that I fear that a visit to Hamilton will be tame after being in Montreal, still I think there is hardly another place in the Dominion where you will be so well treated as in Montreal, but you have to take the little with the great. I move, therefore, that the convention go to Hamilton.

Seconded by Mr. Wyse, of Brantford.

Mr. Gordon J. Henderson : Representing the Hamilton Electric Light & Power Co., I beg to join with the Cataract Power Co. in asking you to come to Hamilton. The work which has been done at St. Catharines so far will, I am sure, prove a benefit to any who come to Hamilton next year. We will do our best to make your stay enjoyable, and trust you will accept the invitation.

On the motion being put to the meeting, it was adopted unanimously.

The President : The next item on the programme is "General Business."

Mr. J. J. Wright : Under that head I would like to have taken up the remuneration of the Secretary of the Association for services during the past year, and move that it be made $125.

Mr. Reesor : I second the motion.

Mr. Kammerer : I also second the motion. I know the amount of work done during the past year, and there is no doubt whatever that it is worth a great deal more than the amount which has been named.

The President : For the past two years I have also known the work that Mr. Mortimer does, and know that $125 is not half enough for the work there is connected with this organization.

The motion was adopted unanimously.

Mr. Hill : I would like to ask if it is the intention of the Association to take any steps in the matter of the action of the Underwriters' Association in regard to inspection, etc., and whether it is the intention to adopt any of the numerous sets of rules that are upon the market, and whether we are to take any action in conjunction with the Fire Underwriters' Association to try and adjust this matter. I don't know whether it is a matter of very great importance to the members from Ontario, but I can say that, speaking from a Montreal view, it is a matter of very great importance. The way in which we have been treated by the underwriters during the last year or two has been, to say the least, very unsatisfactory. We do not know where we stand today or where we will stand to-morrow. To-day it is iron-armored conduit ; to-morrow it is flexible cord ; the next day it is wire on cleats, and the day after wire without cleats, etc. The rulings have been simply surprising, and we think it is about time that the Canadian Electrical Association should take a stand in this matter, and that members should feel that they are not going to be run by inspectors not capable of filling the positions they hold. I therefore bring the matter before you.

Mr. Dion : I am very glad this matter has been brought up. I think we have reached a stage in some parts of the country, in our relations with the insurance inspectors, that calls for some sort of united action on the part of this Association. In Ottawa we have a peculiar state of things. We have a lot of buildings wired years ago when underwriters' rules were not known, and also later when underwriters' rules did exist, but when they were not enforced. It was then in the power of the underwriters to start things right, but they did not, and so things got into a certain groove and continued so until a few years ago. Our company had decided to do no more wiring. Some men without any experience then undertook to do wiring, and it was necessary for the electric companies to protect themselves against bad wiring, and for that purpose they came to the conclusion that no connections would be made to a customer's premises until an underwriter's certificate had been granted. From that day to this we have adhered strictly to that rule, very often to the inconvenience and the annoyance of our customers who were in a hurry to get the light. The result is, that for all customers since that day, we have an official certificate from the underwriters. This certificate has been granted by the official inspector, who, I understand, is under the Ontario branch of the Underwriters' Association. Now, the Quebec board or branch, which seems, as far as I can judge, to have no connection with the Ontario branch, have sent special inspectors, who make reports at variance with the local inspector. A Quebec inspector made an examination of a number of places and made a report which is very damaging in some respects, and unjustly so. Among the places he reported against were a number which had been certified by the local inspector not long ago. Now the proprietors resent this, and they don't want to get the wiring done again, and state, "We have a certificate that the installation has been done in accordance with the underwriters' rules, and if we proceed to have more changes made what guarantee have we that in three or four years we may not be asked to have it done all over again." As far as we are concerned, we don't object to a good set of rules, but we think that there are circumstances where some allowance should be made. My object in speaking about this is to invite discussion so that I can find out what other electric light companies in other cities are doing in the matter. We propose sending a representative from our Board of Directors to confer with the underwriters here in Montreal so as to arrive at a better understanding, and I think it would be well for me to find out what others are doing before proceeding, as it would not be wise for us to move on behalf of Ottawa and some other party on behalf of another town take another stand, but we should all work together.

Mr. W. B. Shaw: Speaking as a supply man and electric light man, and representing construction interests, I have great sympathy with what Mr. Dion has said. I think Mr. Dion must refer to the same inspector who refused to pass on a shunt rheostat because the wires in it were not insulated. I know of one customer here who has given us carte blanche to fill the underwriters' requirements. His wiring was condemned in 1895 by an inspector who was a painter a few weeks before that, and the following year by an inspector who, I believe was a mechanic, and the third year by another inspector whose previous business I don't know. As this customer has given carte blanche to do what the inspectors wanted, he naturally asks now if he has to do something every year. We don't know where we are standing.

Mr. Hill: In order to put this in a proper way for discussion, I would move that the Canadian Electrical Association request the Fire Underwriters' Association of Canada to appoint a competent inspector for the Dominion, whose decision on questions of electrical inspection shall be final, and that we adopt the rules of the National Board of Fire Underwriters.

Seconded by Mr. W. B. Shaw.

The President: My opinion is that the appointment of a small committee to confer with the Association would be a better way to go about it.

Mr. Wyse: The underwriters have the powerful leverage of saying that they won't insure a building that has not been wired in accordance with their rules, and can, therefore, dictate terms to suit themselves. I agree that a committee should be named.

Mr. Dion: Who are the underwriters that are dealing with us? Are they not the Canadian Board of Fire Underwriters' Association?

Mr. Smith: I think I can give Mr. Dion some information. The provinces of Ontario and Quebec are divided by the line of the Kingston and Pembroke Railroad. Everything east is handled by the underwriters with headquarters at Montreal. Everything west is under the control of the Board of Fire Underwriters with headquarters at Toronto, and there is, of course, a central association, but the direct cause of the whole of your trouble comes from the management here in Montreal. If anyone has anything to say about trouble in the west, I am here to answer.

Mr. Dion: Although we are in the eastern district, our local inspector draws his salary and receives his instructions from Toronto.

Mr. Smith: No, he has been entirely under the control of the board at Montreal.

Mr. Dion: Well, he certainly informed me otherwise. One thing I wish to mention is that the local inspector has got the Canadian Underwriters' Code of Rules, and the last inspector who came from Montreal judged the installation under the National Code, and there is, of course, quite a difference between them. The local inspector says he has never received instructions to change the code. Another thing that I wish to mention is that a great deal of the trouble has been due to the fact that the inspections have taken place after the work has been finished. What we want is better local inspection, so that troubles will be discovered immediately after they occur, and not some time after the work is completed.

Mr. Browne: The question of fire underwriters' rules has necessarily been a matter of progress, and in the formulation of these rules undoubtedly a great many grievances have been created. It has been part of my experience to work under the most severe inspection of underwriters' rules, and we found no difficulty in complying with them. I agree with Mr. Dion that in the Quebec section there has been a total absence, until a very short time ago, of any attempt of controlling the method of wiring, and the result is that there is a great deal of bad wiring now extant in Quebec province. Our own experience in this city is unsatisfactory, because there is no established head representing the Board of Fire Underwriters. The Board of Fire Underwriters seems to assume that because they have established rules we will all follow them explicitly and honestly, and that we are so honest, all of us, that we don't need an inspector, and the result is that when they are called upon to make an inspection they often find work done in contravention of the well-known rules. There is not a company in Quebec that does not know that the Quebec Board intend to have the Canadian Fire Underwriters' rules carried out, which are an adaptation of the National Electric Light Association rules. It would be well if a committee from the Canadian Electrical Association, representing those particularly operating in Quebec, could be organized to bring the Quebec Association into the condition that they would appoint an inspector and give him a set of rules, and not leave it to his arbitrary decision to change, so that when we do a piece of wiring we will know it is all right. We don't want an inspector to come around and say, "We want something else done." We must apply to the Canadian Board and get them to appoint an authorized inspector, instead of having one for Ontario, one for Quebec, etc.

Mr. Hill: There are two points that have been brought up at this discussion. The first is the question of the committee. I may say that it has been my pleasure, and at the same time my labor, to go before this Board of Canadian Fire Underwriters in my capacity as a humble citizen, in my capacity as an electrician, as one in the supply trade, and one of the committee of an association we had here, called the Montreal Electric Association. In all these meetings we have done our utmost to have the Fire Underwriters educated up to the proper point, but our meetings have been more than unsatisfactory, for this reason which I want to emphasize, that there is no head, as Mr. Browne has said, and my intention of putting in one head for the Association is that we can get a set of rules for the provinces of Ontario and Quebec alike. Now, if they had a head of that sort, when it came to be a question as to whether interior conduit should be fixed to a brick wall or put through clay tubes, it would not be for an inspector to finally decide on the large installations, but it would go to the head authority, who would be the Dominion Inspector, and it would be his duty to give that decision and stick to it. The great difficulty has been that the inspector has given his decision one day and gone back on it the next, simply because he could not stick to his original decision or had been bought up by somebody. Now, this is a very important question to the members of Quebec, and I think it would be wrong to put it in the hands of a committee, because I believe nothing would come of it. I think if we put before the Fire Underwriters a resolution of this nature, calling upon them to put in a head of that department, that we will gain a point.

Mr. A. A. Wright : If these other gentlemen are in a peculiar position, what kind of a position am I in? The Kingston and Pembroke Railway runs right through the town. Half the town will be on one side and half on the other. (Laughter.)

Mr. John Shaw : Mr. Dion has a kind of compulsory inspection in Ottawa, but we have none here. I know where one of our power companies refused to give light to a building on account of the objection to the wiring, and the consequence was that the party turned around to another company and had the thing done. The whole question is, that this inspection to be of any use must be compulsory, and we should have a municipal law making it so.

Mr. Browne : I indicated in my remarks the very idea that Mr. Shaw has just spoken of—the absence of official authority. I may say that our company has solicited the secretary of the Quebec board to appoint some one with authority to compel the certifying of every installation by the inspector, and that he be given a specific set of rules to be followed, out and that from date all work should be done in accordance with those rules. We have not been successful in having that inspector appointed, and our company is, in its own way, undertaking to impose obligations as to the wiring, but we are frequently met by this condition, that when we undertake to refuse to give light because the wiring has not been properly done, the prospective customer says we have an interest in it because we want to do the wiring and leaves us. If we can get a representative committee of this Association to meet the Quebec Board of Fire Underwriters and impress upon them, if possible, the necessity of appointing some man and giving him a set of rules, we will accomplish a great deal. I believe it to be to the best interests of this Association and of our business generally to secure that. I think in Toronto that Mr. Smith has a good system in force and a fixed set of rules. There is another factor in the case, that is, the American Factory Mutual Associations, who have still more rigid rules than the Canadian Underwriters, and they insist on having the rules complied with. It is not a question of how severe the rules are, but the fact that they will be adhered to. As to the insurance, perhaps your municipal law will cover that. I would have no objection to a municipal officer. All I care about is some authority to regulate this matter.

It was moved by Mr. J. J. Wright as an amendment to Mr. Hill's motion, seconded by Mr. Wyse, of Brantford, "That a committee of the Canadian Electrical Association be appointed, consisting of Messrs. P. G. Gossler, A. A. Dion, F. H. Badger, jr., and Alderman Sadler, to interview the Quebec Board of Fire Underwriters and the municipal authorities in regard to the adoption of permanent rules governing electric installations and a means of enforcing compliance with the same."

(The above amendment is as finally put to the meeting and not as originally proposed).

Mr. Hill : With reference to the amendment, I would say that I would be willing to withdraw my motion provided Mr. Wright will attach the name of some one who is interested in this question. The men who have been most hurt by the inspectors have not been the electrical companies, but the contractors ; and if the contractors —who are an important section of this Association—are not to be recognized as having any say on this subject, I think it wrong. I would therefore suggest that Mr. Wright add to the committee Mr. W. B. Shaw.

Alderman Sadler : Mr. Shaw and Mr. Browne have mentioned the matter with regard to a municipal law. I would like to say to the convention that the building by-laws of the city of Montreal have been somewhat changed ; a committee, consisting of some of the aldermen and also of members of some of the different trades, such as plumbing, etc., have met on a great many occasions during the past eighteen months. Those laws have not been adopted yet by the council, and it seems to me that in fixing a committee, it might be well if they intend to establish certain rules, to have them embodied in some form in the municipal by-laws, because you might come in conflict with our building inspector, and I think it necessary that any laws relating to buildings should also be accepted by the building inspector. If you deem it wise, I would suggest that that committee confer with some of the city representatives ; in fact, as far as I am concerned, I will be only too glad to assist when the building by-law comes up.

Mr. J. J. Wright : With the permission of my seconder, I would amend that motion so as to include conference with the municipal authorities and also add the name of Alderman Sadler.

Mr. Browne : I would suggest that Alderman Sadler remain on the committee. Although in his capacity as representing the city, he would be able to do for us whatever may be necessary there, yet being a member of the committee, working for them, he would be able to present to the council the views of the Association. It has been suggested by Mr. Shaw and also another party that a wiring contractor be added to the committee, and for that part, if Mr. Wright will consent, I would suggest the addition of the name of Mr. W. B. Shaw.

Mr. J. J. Wright : I decline to make any alteration in the amendment.

Mr. Hill : Speaking to the amendment, I would be willing to withdraw the main motion provided I felt the amendment was going to thoroughly cover the point. This is not with me a question of to-day, and I feel that to do full justice to the subject you must widen the scope of that committee. There are very wide interests not represented there, and I fail to see why the mover of the motion, who has been asked by the seconder, refuses to put on that committee a representative from the province of Quebec who has an interest in that committee.

On the amendment being put to vote, 27 members voted yea, and 2 members nay, whereupon the President declared the amendment carried.

Dr. J. K. Johnston then presented his paper, entitled "Experiences of an Inspector." (See page 145.)

DISCUSSION.

Mr. J. J. Wright : Taxers as a rule are not very popular, but in this case I am glad to say that the relations between the taxer and the taxed, as far as I can see, have been of the most amicable nature. I have pleasure in moving a vote of thanks to Dr. Johnston for the good feeling expressed in his paper.

Mr. Dion : In seconding the motion I might, perhaps, refer to the last part of Dr. Johnston's paper, suggesting that there may be some potent charm about electricity. I think this is a phase of an electrician's character that we sometimes overlook, that on account of his coming in contact with so many kickers he cultivates patience and becomes a very genial person.

As Mr. James Milne was unable to be present at the convention, Mr. Weeks kindly read his paper, entitled "The Steam End." (See page 152.)

DISCUSSION.

Mr. Hunt : I suppose it is on account of Mr. Milne's bashfulness that he does not enlarge on the mechanical firemen he speaks about. I may say we have some of these in use, and they are giving good results. I have much pleasure in moving a hearty vote of thanks to Mr. Milne for his paper.

Mr. J. J. Wright : Mr. Milne was right in giving credit to the firemen, as a great advantage can be obtained by the employment of a superior class of firemen. I see his modesty prevents his coming out more strongly in that regard, but the apparatus that Mr. Milne is interested in has every advantage over the ordinary run of such things. It undoubtedly has merits in a good many ways, in its saving of fuel and labor and prevention of smoke. I should like to have discussed these matters more fully, but our time is too limited to go into them.

A paper was then read by Mr. Bonner, entitled, "The Quimby Screw Pump." (See page 149.)

DISCUSSION.

Mr. Thompson asked if the Quimby pump could be used for the ordinary purposes of a suction pump, and Mr. Bonner, explaining that Mr. Quimby was present, asked permission to call upon that gentleman to reply to the enquiry.

Mr. Quimby said : I am much obliged for your permission to address the meeting, and answering the question brought up, the pump described can be used for a suction pump for 10 or 12 days without priming, and if primed will hold anything up to 28 or 30 feet. The pump will answer all the conditions which will be met by any ordinary plunger pump. I recommend them primed at 20 feet, which is about as much as you should run any pump without watching it.

Mr. Reesor : I beg to move a vote of thanks to Mr. Bonner for his able paper.

Seconded by Mr. J. A. Kammerer and carried.

The President then declared the meeting adjourned until the following day at 9:00 a.m.

The afternoon was devoted to a visit to the works of the Lachine Rapids Hydraulic and Land Co., by joint invitation of the owners of the works and the Canadian General Electric Company, by whom the electrical plant was manufactured. Mr. W. McLea Walbank, managing director of the company, was present to give information regarding this important enterprise. After an inspection had been made of the works, the visitors were invited to partake of luncheon, which had been provided by the Canadian General Electric Company. Before starting on the return trip, a very hearty vote of thanks was moved on behalf of the visitors by Senator Thibeaudeau to Mr. Walbank, the directors and officers of the company, and the Canadian General Electric Co., for the courtesies so kindly extended to members and friends of the Association.

THE BANQUET.

The annual Association banquet was served in the Windsor Hotel on the evening of June 29th, and was attended by nearly 150 members and guests. The retiring President, Mr. John Yule, presided, and fulfilled the duties of toast-master.

The Secretary read letters of regret from a number of persons who were unable to be present. Among these was one from Mr. F. C. Armstrong, written while en route to England, the reading of which was followed by the company rising to their feet, at the suggestion of Mr. W. H. Browne, and singing, "He's a Jolly Good Fellow."

MENU.

LONG-DISTANCE TRANSMISSION.
Fire Island Cocktail—50,000 Volts.

INTERNAL RESISTANCE.
Cucumbers. Radishes. Tomatoes, Strain Insulators.
Olives, triple Braided.

ELECTRIC JUICE.
Green Turtle, a la Water Rheostat.
Cream of Asparagus, a la Ozone.

SUBMARINE.
Saguenay Salmon, a la Hello. Potatoes, Rachel.

SHUNTS.
Spring Lamb Cotelettes, Carbon-Trimmed. Sweet Breads.
Asparagus—"Arrester" Points.

JOINTS—"Soldered and Taped."
Fillets of Beef, Larded.

RELAYS AND SOUNDERS.
String Beans. Boiled New Potatoes, Anchors. Cauliflower.
Asparagus. Sweet Peas.

TROLLEY OFF.
Punch au Champagne.

RECONSTRUCTION.
Roast Philadelphia Capon.

PLANTS.
Lettuce and Tomato Salad.

BOOSTERS.
Cabinet Pudding, "sound-proof."
Gelee aux Oranges, "insulating compound."
Savarin aux Aananas, "Vacuum Light."
Vanilla Ice Cream, "self cooler."
Sponge Cakes, "Leather Belting."

DESSERT.
Fruits, "potential currents." Nuts and "wrenches."

ELECTRIC HEATER. INCANDESCENCE.
Cafe Noir. Cigars.

TRANSFER. RING OFF. OPEN CIRCUIT. "30."

The appended copy of the menu will suffice to show its unique and excellent character. The toasts honored on the occasion were : "The Queen," "Electrical Montreal," "Our Association," "Our Guests," "Electrical Research," "Allied Interests," "The Press" and "The Ladies." His Worship, Mayor Prefontaine, responding to "Electrical Montreal," gave a number of interesting and instructive particulars regarding the electrical development of the city. The Royal Electric Co. began in 1884 with a dynamo of 13 arc light capacity, a dozen employees, a small workshop, and a capital of less than $50,000. To-day it has a manufactory covering an area of about 40,000 square feet. The total employees of the company in its manufacturing business is upwards of 500 ; its capital invested upwards of $2,500,000. In 1886 the streets of Montreal were first illuminated by electric light, 113 lights being then placed. To-day there are nearly 1,500 street lights. The Chambly Manufacturing Company's enterprise, by which electric current will be transmitted to Montreal not later than September next, represents a development to the extent of 20,000 horse power. Another enterprise which was a credit to Montreal was the Lachine Rapids Hydraulic and Land Company's development, where a capital of nearly $2,500,000 is being expended to harness the St. Lawrence. In August, 1892, the street railway began operations by electric power, with two dynamos, of a total capacity of about 500 horse power. To-day it has installed a capacity of about 10,00 horse power. They have 80 miles of track. In 1894 the Montreal Park and Island Railway was begun. It is now running to Back River, Outremont, St. Laurent, Cartierville, Westmount and Lachine. It has a track mileage of about 60 miles. The Bell Telephone Company has somewhere about 8,000 telephones in use in the city, besides those of the Merchants' Company, numbering about 1,200.

Hon. Senator Thibeaudeau, speaking for "Our Guests," referred to the transformation which electricity in its varied applications had wrought throughout the Dominion.

In the absence of Prof. Herdt, due to illness in his family, Mr. W. H. Browne ably responded to the toast, "Electrical Research."

The "Allied Interests" were responded to by Ald. Sadler and Mr. D. A. McDonald, Montreal; Messrs. C. L. Weeks and J. A. Kammerer, Toronto; Mr. E. E. Cary, St. Catharines.

Mr. B. A. MacNab, formerly a knight of the telegraph key, responded for "The Press," and for "The Ladies," Dr. W. H. Drummond recited a poem descriptive of the heroism of a young Quebec girl, Madeline Verchere, in 1692. Dr. Drummond in like manner favored the company at an earlier stage in the evening.

In addition to the pleasure derived from the presence of an excellent orchestra, the company greatly enjoyed the singing of Mr. Fred. Hickey, Mr. J. R. Wilkes and Mr. Ernest R. Jenkling.

THIRD DAY.

The convention re-assembled at 9:30 a.m., when the election of officers was proceeded with.

For the office of president Mr. Cary nominated Mr. W. H. Browne, of Montreal. This was seconded by Mr. John Shaw, and meeting with universal approval of the members, Mr. Yule declared Mr. Browne to be the unanimous choice of the Association for the office of president for the ensuing year.

Mr. J. J. Wright nominated Mr. H. P. Dwight, of Toronto, for the office of first vice-president. Mr. Dwight was declared to be unanimously elected.

Mr. J. A. Kammerer nominated Mr. A. A. Dion, of Ottawa, for second vice-president. Carried unanimously.

The following members were elected to constitute the Executive Committee: J. J. Wright, A. B. Smith, Toronto; John Carroll, William Thompson, W. McLea Walbank, Montreal; G. J. Henderson, H. R. Leyden, George Black, Hamilton; O. Higman, Ottawa; E. E. Cary, St. Catharines.

A hearty vote of thanks was tendered to Mr. Yule for his services as president of the Association during the past two years.

It was moved by Mr. J. J. Wright, seconded by Mr. A. A. Wright, and resolved, that the most hearty thanks of the Association be tendered to the following gentlemen for the very handsome manner in which they have looked after the interests and comfort of the visiting members and for hospitalities extended: Members of the Reception Committee; Montreal Street Railway Co.; Canadian General Electric Co.; Lachine Rapids, Hydraulic & Land Co.; Montreal Park and Island Railway Co.; Royal Electric Co.; Chambly Mfg. Co.; McGill University; Montreal Belt Line Railway Co.; Windsor Hotel Co.; Great North Western Telegraph Co.; Canadian Pacific Railway Telegraph Co.; Bell Telephone Co.; R. E. T. Pringle; Packard Electric Co.; Eugene Phillips Electric Co.; Dominion Wire Mfg. Co.; Ness, McLaren & Bate; D. W. McLaren Co.; Sadler & Haworth; W. T. Bonner (Babcock & Wilcox Co.); W. E. Gower (Street Railway Chambers); members of the local press.

VISIT TO MCGILL UNIVERSITY.

Upon adjournment, the members and their friends proceeded to McGill University. Experiments had been prepared in the electrical laboratories in view of the visit of the members of the Association, but, owing to the little time at their disposal, all of the experiments prepared could not be carried out.

In the McDonald Engineering Building, the experimental rooms, testing rooms and laboratories were thrown open to the visitors, and the extensive collections of standard instruments, models, etc., called forth loud praise from the visitors.

In the dynamo room, the very fine equipment of dynamos and motors was seen running. Of special interest to the electrical fraternity was the 12 k.w. Mordey alternator, the coils of which can be moved round through any angle and two or three currents of any phase difference obtained. The mains leading from this machine are led to the high tension current laboratory on the floor above. It is there that the special work of research on alternating current is carried out. A speed indicator and speed regulator of a novel form enables the experimenters to regulate at will the speed of the motor driving this alternator. A little model of a two-phase motor, as shown in Fig. 1, was set up. It consists of a ring of cast iron, with four inside polar projections. There are four bobbins wound on these. The windings A and A^1 are in series, and independent of windings B and B^1, also in series. In the centre is placed a flexible cast iron rod, C, firmly held at one extremity; the other end carries a plane mirror, b. A ray of light is thrown on this mirror, and is reflected on a pane of ground glass, d.

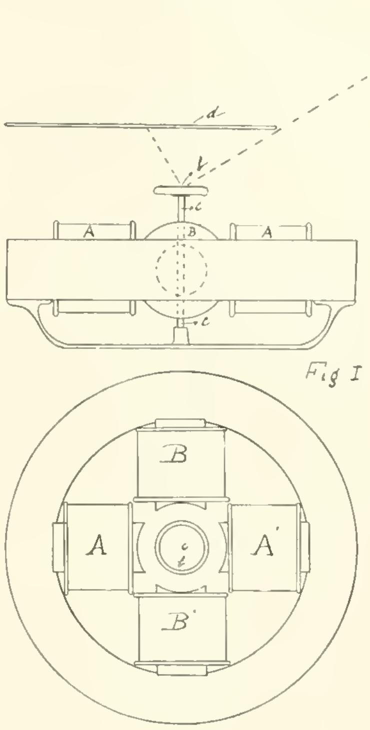
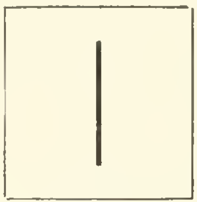
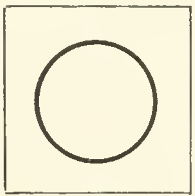


Fig I

If an alternating current is sent into the coils B and B^1, a pulsating field is produced, and the rod C will be set vibrating. A stream of light will be cast on the glass, as shown in diagram A. If a second alternating current of 90° difference of phase is sent into windings A A^1, a pulsating field is produced at right angles to the first one, and will cast a ray of light as shown in diagram B. If the two currents are acting at the same time and are of the same value, a rotating field is set up; this rotating field is shown by a circle clearly drawn out on the plate C. If the difference in phase between the two currents is more or less than 90°, the curve drawn out is no longer a circle, but will be of elliptical form. A number of interesting experiments can be carried out with this very simple apparatus. A little drum of copper placed inside the motor will start to rotate.


A

B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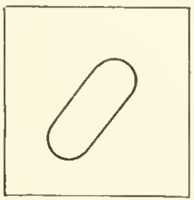
D

Another apparatus (Fig. 2) for similar work, but of much greater value and more remarkable results, was also set up. It was devised by Prof. Carus-Wilson, and consists of a small mirror pivoted at its centre and attached to a wire, v, capable of a vertical displacement, and also to another wire, h, with a horizontal displacement. These wires, in which were passed alternating currents, are placed in constant magnetic fields. The mirror, following the relative displacements of the wires v and h, and through a reflected ray of light, beautifully draw out the approximate line curves of the alternator.

In the lecture theatre of the Physics building the visitors were shown each in turn the power of the X rays to throw a shadow of one's anatomy on the fluorescent screen. They were then given a demonstration of the breaking down of the insulation afforded by a large glass plate by a very high potential alternating electric discharge. For this purpose a large induction coil was used as a transformer, the primary being connected to the street mains. The demonstration was closed by a display of a few of the fine Geissler tubes belonging to the well-known collection of the McDonald Physics building. The lighting and power plant of the University was also inspected by the visitors.

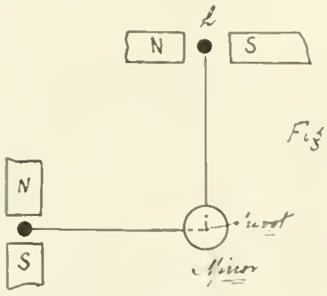

Fig 2

At 1 p.m. a visit of inspection was made to the headquarters of the Bell Telephone Co. and the manufactory and lighting station of the Royal Electric Co. At 3 p.m. members and invited guests were conveyed by special train to the electric transmission works of the Chambly Manufacturing Co., where luncheon was served.

The convention then closed.

SPARKS.

The town of Thorold purposes extending its electric light plant, and will issue debentures for $7,000 for the purpose.

The ratepayers of Listowel, Ont., recently defeated a by-law to provide funds for increasing the electric light plant.

It is claimed that the necessary capital has been secured to build the proposed Lanark and Perth electric railway.

The Lakeport Preserving Company have given an order for the installation of a lighting plant for their factory to the Canadian General Electric Co.

The Toronto Railway Co., who recently ordered a number of Canadian General Electric C.G.E. 1000 motors, has given an order for additional equipments.

The town of Whitby, Ont., invites tenders up to July 30th for lighting the streets of the town. Thomas D. Jackson is chairman of the Committee on Street Lighting.

The Central Electric Light Co., of Portage la Prairie, Man., are said to have under consideration the equipment of a telephone exchange, in opposition to the present company.

The city of London is advertising for tenders for the supply of an electric light plant of 350 2,000 c.p. capacity, together with steam plant for operating same. Tenders close August 3rd.

The Hull Electric Co. recently elected the following board of directors; Messrs. A. Fraser, president; W. J. Conroy, vice-president; C. Magee, J. B. Fraser, R. J. Conroy, W. N. Taylor and David MacLaren.

The Laprairie Bay Ice Co., with a capital of $100,000, has been organized in Montreal, for the purpose of supplying ice cut by a patent electric ice-cutting machine, the invention of G. D. Pearson. Power for operating this machine, as well as for an electric hauling apparatus, will be obtained from the Lachine Rapids Hydraulic & Land Co.

The Lachine Rapids Hydraulic and Land Company, of Montreal, have given an order to the Canadian General Electric Company for the installation of a seven panel power house switchboard, which is to be built in accordance with specifications and drawings prepared by R. S. Kelsch, superintendent for the Lachine Rapids Co.

The Canadian Pacific Railway, which have recently acquired the smelter at Trail, B.C., formerly operated by Aug. Heinze, have concluded negotiations with the West Kootenay Power & Light Co. for the supply of electric current to operate their smelter, and have ordered from the Canadian General Electric Co. two 75 k.w. three phase revolving armature type synchronous motors, which will be operated at a potential of 550 volts. They have also ordered three 50 h.p. induction motors and three 30 h.p. induction motors, which will also be operated at a potential of 550 volts.

British capitalists are said to have secured a controlling interest in the New Westminster & Burrard Inlet Telephone Co., of Vancouver, B. C.

Edward Slade, electrical contractor, of Quebec, is installing an electric plant in the steel boat Orleans, plying between Quebec and St. Tetronille.

The Robb Engineering Co., of Amherst, N.S., has received an order for two engines of thirty horse power each, for running blowers in the works of the Verity Plough Company, Brantford, Ont.

The electric light plant of McCurdy & Co., Antigonish, N.S., is being extended, the company having secured the contract to light the streets of the town. The Robb Engineering Co. are supplying the engine and boiler.

The R. Forbes Co., Limited, of Hespeler, Ont., have placed an order with the Canadian General Electric Co. for two 500-light generators. These generators will be of the Canadian General Electric Co.'s latest four-pole type.

The City Council of St. Thomas, Ont., have appointed a committee, consisting of Aldermen Chant, Wallace, McCully, Sanders and Robertson, to report as to the advisability of establishing a municipal electric plant for street lighting and commercial purposes.

The West Kootenay Power & Light Co., who have just closed a contract with the C. P. R. authorities for the supply of electric current to operate their Trial smelter, have placed an order with the Canadian General Electric Company for the supply of three 135 k.w. transformers of the well known air blast sub-station type.

The Dominion Telegraph Co., at its annual meeting held last week, re-elected directors as follows: Thomas Swinyard, president; Hon. Sir Frank Smith, vice-president; General Thos. T. Eckert, Chas. A. Tinker, A. G. Ramsay, Henry Pellatt, Hector Mackenzie, Thos. F. Clark, Thos. R. Wood, and F. Roper, secretary and treasurer.

The town of Barrie, Ont., recently invited tenders for an electric light plant, to be operated under municipal control. It is understood that a number of tenders were received, and that the Electric Light Committee have recommended that a by-law be submitted to the Council to raise the sum of $35,000 to purchase and install a plant for arc, incandescent and power services.

The attention of the electrical fraternity and others interested is directed to the advertisement of the Croftan Storage Battery Company on another page, and also to the description of the battery which appears in this issue. The Croftan battery undoubtedly has many points of merit, and the company have good prospects of building up quite an extensive business in Canada.

The Napanee Electric Light & Water Co., which has been supplying lights for the streets of Napanee during the past ten years, has decided to go into the incandescent electric lighting business, and for this purpose has placed an order with the Royal Electric Co. for a 35 k.w. two phase generator and 500 light capacity in transformers. The company has already secured in the neighborhood of 400 lights, and expect to have the generator fully loaded within the next two or three months. They are arranging the plant so that an enlargement can easily be made.

The Lang Tanning Co., of Berlin, Ont., have recently given an order to the Canadian General Electric Co. for a 100 k. w. multipolar direct current dynamo, which will be operated at a potential of 250 volts. This generator will supply current for the operation of two of the Canadian General Electric Co.'s latest type of multipolar direct current motors, each having a capacity of 50 h.p., and one 10 h.p. motor. The order given to the Canadian General Electric Company also includes the installation of a marble panel switchboard containing the necessary instruments for the operation of the plant, and the wiring up of their factory.

The second annual meeting of the Canadian Telephone Co. was held at Sawyerville, Que., on June 27th, when the following were elected directors for the current year: J. Laroche, Sawyerville; A. Adam, Paquetteville; Jos. Lemieux, St. Malo; P. A. Barbeau, Cookshire; Jas. Hunt, M.L.A., Bury; F. F. Willard, Angus; E. Roberge, Notre Dame des Bois; N. P. Tanguay, Weedon; and M. Matheson, Lake Megantic. Mr. H. Laroche was re-elected president, Mr. Joseph Lemieux general-manager, and Mr. J. Fournier secretary-treasurer. A dividend of 5 per cent. for the past year was declared. The report stated that the company had built during the past year 60 miles of poles, with 114 miles of wire, and actually owned 220 miles of poles and 347 miles of wire. The company have 12 exchanges, with 322 subscribers.

Last week the town of Perth, Ont., was visited by the largest fire it has experienced since its existence. The new waterworks system was put to a practical test and worked admirably. The water pressure remained perfectly steady and even. This is, we believe, the first instance in Canada where the waterworks pumps were electrically driven, and from the satisfaction given at Perth by the use of electrical apparatus, other cities with the waterworks operated from a steam plant, and where electrical power is available, will no doubt sooner or later adopt the use of electricity. The installation of the pumps, generators and motors was conducted by the Royal Electric Co., and the motor used for pumping purposes is one of their 75 k.w. "S.K.C." two phase machines operating as a synchronous motor from a 180 k.w. "S.K.C." generator situated at a water power six miles distant.

The corporation of the city of Joliette, Que., is remodelling their entire system of electric lighting. This corporation has a water power in the city which has been utilized for supplying arc and incandescent lighting throughout the city. The contract for the work has been awarded to the Royal Electric Co., who will supply a 180 k.w. "S.K C." two phase generator and the necessary arc apparatus to replace all the old machinery. The matter of making the change has been hanging fire for a long time, and after consultation with the best engineering skill obtainable the council came to the conclusion that it would be better to change over the whole plant than to repair the old apparatus, or make additions of less efficient or up-to-date apparatus. The changing of this plant should be gratifying to the electrical trade, as it shows the trend of investors, and the corporation of Joliette is also to be congratulated on the up-to-date stand which they have taken in the matter.

ELECTRIC UTILIZATION OF WATER POWERS.

By L. D. W. Magie.

The utilization of power going to waste in fast running streams has commanded for many centuries the attention of mankind. Regarded, on the whole, as "wasted energy" and as power that could be obtained "for nothing," the question of how to make it useful perplexed our forefathers, and is still giving us some study to-day. Although it would appear that, during the reign of Augustus, about 40 A.D., the first water wheels were made and used by the Romans, the scientific development of the water wheel appears to have been left until the present era, for until within the last few years, comparatively, the only devices used to convert the kinetic energy of streams into effective mechanical energy were the various forms of undershot and overshot wheels.

Crude as were these instruments, they have played a most important part in the world's history, for they have done much to develop countries with natural resources.

Manufacturers who sought cheap power adopted the "wheels" available and located their plants along favorable streams, where these crude transformers of energy were made to grind corn, saw wood, make cloth, etc.

The inventors of the present century awakened to the necessity of improvement and have provided the present types of wheels. To their higher perfection and adaptability is due the fact that almost every power producing stream in settled districts of the civilized world is utilized.

The harnessing of water powers is not an easy task, but requires a great deal of thought, scheming, trying and fitting by the engineer. The records of the stream have to be looked up and studied into, with reference to high and low water, during a period covering many years, and due provision made for getting rid of the maximum flood of every season.

The possible storage capacity must be looked after, for oftentimes by a little forethought and a comparatively slight additional expenditure, a stream that naturally gets very dry at certain seasons can be made, by properly arranged storage, to give a practically constant output the year round.

Again, by carefully arranging the surrounding conditions, a stream may be made to give for a comparatively short period, when power may especially demand, double or triple its normal output capacity.

Probably one of the most important things to study, especially in localities subject to severe winters, is the question of frazile or anchor ice. This is a condition which has caused hundreds of thousands of dollars to be spent, either from the lack of knowledge or want of forethought; in some cases the conditions have been such as to make it almost impossible to successfully cope with them, without expending such sums of money as to practically ruin the enterprise. To overcome it successfully, the only way seems to be to provide a large pond of still water, extending to as great a distance as possible, even several miles, if attainable.

Many other details must also be studied before determining the best location of the water motor power house, so as to obtain the greatest available head with the least expenditure. In the study of the question the natural conditions of the soil, water and climate, all have an important bearing, on not only the engineering success, but also on the financial success of the enterprise.

As water falls cannot themselves be moved from one place to another, manufacturers have had to locate the sites of their plants at the falls. In many cases it is necessary, and in nearly every instance very desirable, that the power be transmitted to a certain distance. When the distance has been comparatively short it has been accomplished by belting, gears and line shafts, but when the distance extends beyond a few hundred feet, this system becomes so inefficient, expensive or impracticable that some other way has to be found.

Rope transmission has been used quite successfully, even to a distance of a mile, and in a few instances over that distance, but as the best practical efficiency is not over 60%, and the first cost, as well as maintenance, is usually very high, this system has not yet been so successful as to command its adoption very extensively.

Compressed air has also been used for the transmission of energy with some success, more particularly in Paris, where there is a large plant still in existence; but here again the engineering cost has been great, efficiencies low, and maintenance high, and consequently, like the rope transmission system, has not met with general use and practice.

The electric dynamo and motor have given an entirely different aspect to the transmission of energy. Although invented in the early part of this century, it is, however, only within the last few years that the electric dynamo and motor have been developed practically and commercially.

The success and high efficiency attained by electric transmission of energy is such that the "water fall" is gaining prominence as a source of energy.

The pioneer work in electrical transmission was done with direct current system, and too much credit cannot be given for achievements attained. However, although in a few instances the distance transmitted by the direct current system has been up to twelve miles, yet, on the whole, for commercial reasons it has not been desirable to transmit power by direct current to a distance of over two miles, and even the advisability of this is looked upon to-day doubtfully. The reason for this is not because of the inability to transmit the power effectively, but because of the inadaptability of direct current apparatus for use at high voltages. The construction of direct current machines is such, having, as they do, so many auxiliary parts, that at high voltages they are very liable to break down, especially at the commutator and armature cores, except with very costly construction, and even then they are not at all sure; at high voltages the brushes are liable to spark and cause trouble at the commutator; and as the high tension parts require continual attention and adjustment while the machines are in motion, they are dangerous to the attendants.

Probably, however, one of the most important reasons for the indaptability of direct current machines for long distance transmission at high voltages, is the inability to reduce the voltage to that at which it would be safe to operate at the place of consumption without the use of expensive and cumbersome as well as inefficient banks of motors. Such motors of high voltages, having parts under high tension, which require attention and adjustment while in motion, could not or rather should not be used except under the care of expensive special experts in every separate mill or factory where such motors were installed. To place them in the care of uneducated men would be unwise, and, in fact, foolhardy.

The highest voltage that D.C. apparatus can be wound for, commercially and safely, seems to be, as universally adopted, from 500 to 600 volts. The reason that power at this voltage cannot be transmitted great distances is purely a commercial one. There is no electrical reason why power by the means of direct current might not be transmitted to an indefinite distance, entirely effectively and successfully.

The amount of copper required for the transmission of power is directly proportionate to the amount of power to be transmitted, and also directly proportionate to the square of the distance for a given efficiency. This may be stated commercially by the amount of copper required for transmitting, say, 100 h.p. for both one and ten miles, the loss in transmission to be 8% and the voltage to be 500 volts.

For each leg of a one mile circuit there would be required two No. 0000 wires, or four No. 0000 wires, each one mile long, weighing 15,312 pounds, which at 15 cents per pound would cost $2,300. For each leg of the ten mile line there would be required twenty No. 0000 wires or forty No. 0000 wires, each ten miles long, weighing 1,531,200 pounds, which at 15 cents per pound would cost $230,000; or the power would cost, at 10% interest and depreciation on copper alone, $2.30 per h.p. annum in the first instance, and $230 per h.p. annum in the second case.

If, however, the voltage be raised to 5,000 volts, and be used for transmitting 100 h.p. for ten miles, the condition would be entirely different, for instead of forty No. 0000 wires, each ten miles long, there would be required for each leg but one No. 4 or two No. 4 wires each ten miles long, weighing 15,300 pounds, which at 15 cents per pound would cost $2,300, or the same as transmitting the same amount of energy only one mile at 500 volts.

From the above it will be seen that the transmission of power at 500 volts is not entirely prohibitive for short distances, but as the distance increases it becomes one of vital importance, for the cost of copper is not the only item of expense then to be considered; the pole line itself becomes a very grave matter, especially when we have to consider the weight of forty No. 0000 wires, as in the example for only 100 h.p., and the cost becomes one that investors cannot afford, for the reason that power can be obtained cheaper from other sources, so that commercial transmission of power long distances by direct current at practical voltages is not practicable.

Although, as stated before, considerably higher voltage than 500 volts has been used with some success, as at Brescia, the number of such plants are very few.

It is a noteworthy fact that on this continent, where the transmission of energy is further advanced than anywhere else, there is not a single plant of any prominence that is transmitting energy by high tension direct current system.

It may be interesting to know that three or four years ago, when the Chambly plant was first discussed, a European firm planned out and tendered for the construction of that plant for transmitting the energy by means of this high tension direct current system, but, for reasons as above discussed, that system was not adopted.

How to meet the problem of long distance transmission, commercially and efficiently, has been left almost entirely to the alternating current system.

Alternating currents were known about the same time as direct currents, or about 1831, and were explained to the world by the great Faraday, who at that time discovered the elementary principles. From that time on, experiments were made by different inventors on induction coils, but no material progress was attained until May 22nd, 1877, when Jablochkoff obtained British patents for "a new process of producing and dividing the electric light and apparatus therefor."

There were also other inventors at about this time who produced "improved induction coils on secondary generators," as some of them were called, but all seemed to have the idea that they could be operated with their primary coils connected in series, and that their secondaries could be independently controlled.

In 1878 a J. B. Fuller, of New York, suggested a system of using induction coils or transformers in parallel, but no practical results seemed to have been obtained in this direction until 1882, when Messrs. Goulard and Gibbs exhibited two induction coils at the Electrical Exhibition held in Westminster Aquarium in London, which ran in operation from the Siemens alternator.

In the autumn of 1884, Messrs. Goulard and Gibbs gave another exhibition at Turin. In this case, the primary circuit was nearly 50 miles in length. A series of transformers were placed on this line, one being in the Exhibition Building, one at the Turin Railway Station at Verine Riesla; another at Lanzo, a small village in the Alps of Savoy; incandescent and arc lamps were supplied at the various places.

The first parallel system that was started on this continent was by Wm. Stanley, Jr., in 1884, in the small town of Great Barrington, Mass., where light was supplied throughout the town by means of a parallel alternating current transformer system. From about this time commenced the era of alternating currents, although as far back as 1849 alternating current generators were devised.

Commencing with 1885 the alternating current system made great strides.

To employ waterfalls as sources of cheap power, high potentials became necessary. For these conditions the A. C. was especially effective; the ability to step up from low potentials to high, and thus transmit power to a given distance, then to step down to safe and convenient voltages, entirely effectively, conveniently and without the use of cumbrous and expensive apparatus, rendered the transportation of the energy of water powers feasible and commercial.

Probably one of the first high voltage transmission experiments on this continent was in December 1891, and in January and February, 1892, at Pittsfield, Mass., at which test the writer had the pleasure of participating. The potential used was approximately 15,000 volts. A transmission line about a mile in length was built in an open lot a little ways out of town, where a small experimental station was built. The current was received from the local Electric Light Co. at 1000 volts, raised to about 16,000, sent out on the line, and thence returned, again lowered, first to 1000 volts, and then again to 100 volts, at which voltage energy was consumed in water rheostats. On the line experiments were made with porcelain insulators, as well as the oil type of insulators.

At this time, of course, comparatively little was known about electric current at this potential, so that everything had to be handled with gloves, as it were. The experiment proved to be not only useful and satisfactory, but highly successful, and gave considerable encouragement.

Although experiments were commenced, and discoveries made pointing to the advancement of A. C. motors in 1879, still practical results of any real value were not obtained until in the year 1890 to 1891, when the poly-phase systems were introduced. From that time it can be truly said that water powers could be utilized for the general distribution of power at distant localities.

One of the first and most notable exhibitions of this kind was made at the celebrated Frankfort Exposition in 1891, which proved not only interesting to the town of Frankfort, but to the world at large, for it taught lessons and set aside errors that would have taken years of toil and hard labor to have done otherwise.

Poly-phase generators having a total capacity of 300 h.p. were installed at Lauffen and operated by water power. From these, the current was transmitted a distance of 110 miles to Frankfort; several voltages were tried on the transmission line during the experiment, the highest of which was 31,000 volts; in the exhibition grounds were arc and incandescent lamps and small alternating current motors, all provided with current from the hitherto "wasted energy" of the streams of Lauffen, and with a loss of efficiency in the line of not more than 25%, which, at that time, was certainly a most noteworthy accomplishment.

During the next two or three years manufacturers spent a great deal of time and energy in perfecting their systems. The induction motor has been perfected to that of an ideal, and the usefulness and necessity of synchronous motors have been extablished.

For a few years following 1891, an occasional polyphase plant was put up in different parts of the world. They were subjected to all sorts and kinds of trials, depending upon the character of the work to be performed at each individual installation, and although there was often much cold water thrown upon them at the start, and obstacles placed in their way, still they always came out ahead and proved a success, not only from the engineering point of view, but to the financial backers.

When we stop to consider that it has been only within the past six or seven years that a complete system has been devised for the utilization of distant water powers, and that all of the important transmission plants have been put in during that time, it is no wonder that there are yet some sceptics. But perhaps worse for healthful commercial developments are those who make a wild rush for some transmission scheme, without first considering all of its surrounding conditions, thinking that because someone else has made a certain project successful, their project must be also. It falls upon the engineer to bring the sceptic to lines of true reasoning and to teach him facts in their true light, so that he will see and believe, that with such resources at his command, great things are possible ; the engineer must also hold the enthusiast in check and prevent waste of money in impracticable undertakings.

The primary or fundamental question is to ascertain the point at which transmission of water powers will be a source of profit to the investor.

Many people think that because water strictly follows certain given laws of nature, and in doing so continually and constantly exerts energy, therefore the energy obtained thereby costs nothing.

People with such ideas are fortunately gradually growing less as time progresses, although the engineer often encounters men who have a few hundred h.p., or often times when the true facts present themselves, only 25 or 50 h.p., that they wish to transmit 5 or even 10 miles, in hopes of making vast sums of money by the use of this transmitted power in some small town for lighting and power.

The cost of electrically transmitted power is represented by the interest on the capital invested ; the depreciation ; the maintenace ; the operating expenses and numerous other small contingencies, and besides, in some cases, the amount of money that has to be expended for water and land privileges. The sum of these accounts per year, divided by the amount of h.p. actually sold, will be the actual cost per h.p. for the case in question.

Probably the greatest competitor to electric power is steam power. In a few instances, power derived from gas or petroleum engines may also compete. The cost of producing steam power in any given locality is a fair criterion by which to determine how much electric power should cost. The cost of power produced from other sources can usually be disregarded.

The cost at which steam power can be produced in a given locality being ascertained, it can be determined what cost per h.p. may be expended on the construction of an electrical transmission plant to make it profitable to the investor, provided again a sufficient market can be obtained for power.

When electrically transmitted power does not cost more than $100 to $140 per h.p. installed, the investment is apt to be a profitable one, providing, of course, it is properly managed.

But what should it cost to harness and utilize water powers ? This is a question that has to be figured out for each individual case, for there are hardly two plants where exactly the same conditions exist.

The first item of expense is amount required for water privileges. In some cases this is rather an unimportant consideration, while in others it is the chief expenditure, for it may involve the buying of thousands of acres of land surrounding the stream, because the necessary dams may cause to be submerged a great deal of valuable land, or large tracts have to be bought for building storage reservoirs, or the right of way for pipe lines, etc., have to be secured.

When land is cheap, these considerations are often not objectionable, but where good farming land, or land valuable for other reasons, has to be thrown to waste, the question is often a perplexing one.

The cost of the dam, power house and hydraulic machinery is, as a rule, dependent almost entirely on the characteristics of the stream being utilized. Entering into the question is the amount of water in the stream, both under normal as well as abnormal conditions at various seasons of the year ; also the head or fall and whether it is dependent on natural conditions or requires the building of large dams.

Generally speaking, other things remaining equal, generating plants, comprising the power house, hydraulic and electric machinery, as a whole cost less as the head increases, until certain limits have been reached.

When the head is low, as ranging from 4 to 10 feet, it requires a comparatively large wheel for a relatively small amount of power, and then slow speeds can only be attained. Where large units are desirable, a number of these wheels must be coupled together in order to get the required power. The speed attainable can be raised or lowered to a certain extent, depending on the size of the wheel. If higher speeds at low heads be desired for large units, many wheels must be operated together, requiring not only a great deal of room, and consequently larger power house, but considerable line shafting, gears, couplings, etc., which not only increase the initial cost, but increase expenditure of operation and maintenance of the plant, as well as introducing another source of inefficiency.

With higher heads a larger amount of power can be obtained from fewer and smaller wheels with higher speeds, and, therefore, cheaper generating apparatus.

The cost of generating apparatus for a given capacity, other things remaining equal, is almost directly proportional to the speed at which it runs, and for this reason it is always desirable to refrain from too low speeds wherever possible.

There are many people who are imbued with the idea that it is impossible to build a modern station without direct connecting all of their apparatus, and that belting at no time should be used.

Although direct connection is desirable, still it must not be carried to extremes.

A good engineer will hardly warrant the expenditure of, say, $15,000 for a 300 k.w. generator to run at a speed of say 75 to 100 r.p.m., when a machine just as good in every respect, and sometimes better (because it is a standard size), can be bought in belted units for $5,000. Yet this is sometimes done, burdening the plant with many thousands of dollars on which it has to pay money, for no other reason than that "so-and-so's plant is direct connected and I want a plant just as nice and good as his, and belts are always an awful nuisance."

As stated before, direct connected units are always desirable where conditions will warrant them, still it must be borne in mind that belts have been in successful operation now for a good many years, and there are many instances where the maintenance of them has not cost 1% per annum, and although their use involves a loss of efficiency of somewhere between 2 and 3 per cent. at times of full load, still this loss in a water power plant is not a critical amount, and in fact is almost always inappreciable.

The next item of considerable expense is the transmission line—always rather an uncertain item, on account of its variations in cost for different distances and the conditions of local distribution.

The poles, with their appurtenances, exclusive of wire, will cost between $250 to $500 per mile, varying according to circumstances.

Rights of way for the placing of poles may often be expensive.

The transmission wire must be considered separately.

Reference has been made earlier herein to the voltage or size of wire. The voltage at which it is practicable to run now-a-days is reaching vast proportions. There are two or three plants being installed in which 20,000 to 22,500 volts will be used, and a plant is likely to be installed soon that will use 60,000 volts.

The use of high voltages in the past has been limited greatly by the insulators. The glass insulator has proven itself insufficient for most climatic conditions. The oil type of insulators was introduced some years ago, and a great deal expected from them. They did give excellent results in the laboratory, but unfortunately the oil evaporates, and the impracticability of renewing the oil, especially when the line is in use, soon put them in disfavor.

Porcelain insulators appear to have solved the problem. The trouble at first was to get them properly vitrified, but this difficulty seems now to be overcome, and the insulators have proven all that can be desired when used with the usual voltages now employed. As to whether they will successfully cope with the higher voltages now contemplated is a question yet to be answered.

The cost of the transmission wire is often the most important part, but is always different with each case, dependent, as it is, upon the amount of power to be transmitted, the transmitting voltage, distance, and the allowable loss. As a whole, it is always best to keep the transmitting voltage as low as possible and still keep within commercial conditions. Many people are carried away with the idea that if they could only use high voltages the cost of transmitting would be reduced to a minimum.

It must be borne in mind that with the use of the higher voltages the cost of insulators increases, the electrical apparatus necessarily costs more, and moreover, the risks are greater throughout the system, and consequently necessitates more skilled attendants to look after the plant.

All of these items have to be carefully considered before looking into the possible saving of copper on the line.

For mechanical reasons, a wire smaller than No. 6 B. & S. should not be used for line work. More cautious engineers will say it should not be smaller than No. 4 B. & S. It is foolish to attempt to use voltages which allow the use of smaller than No. 6 wire. Where a shut-down would mean heavy damages, it might be even advisable to use a wire not smaller than a No. 2 B. & S.

If these facts are always borne in mind, the question of voltage will often times adjust itself, and the use of very high voltages will not be found necessary unless the transmission be for especially long distances, and the amount of power particularly large.

The permissable drop is dependent upon the power obtainable at the generating station and the amount to be delivered at the end of the line. There are a few instances where power is scarce at both ends of the line, and where it is desirable for this reason to keep the loss of transmission as low as possible, but such cases as a rule are rare, and we are more often met with the reversed conditions.

To get good results electrically, the loss in the line should not be more than 15°/o. If it be more, it will, with the other losses that are necessary in the rest of the apparatus, especially where the load is liable to be a fluctuating one, render good service almost impossible.

The figuring of drop on transmission lines should always be left to competent engineers, for with A. C. the question in many instances is not a simple one, because it involves other conditions besides the ohmic drop. When alternating current is sent through a conductor, it has to deal not only with the electric resistance of the wire, but also with a resistance due to the fact that the electric magnetic stresses set up at any point of the conductor, create electromotive forces at other points of the same conductor, which oppose and retard the passage of the current, or in some cases, tend to shove it ahead.

As to how far power can be transmitted, the engineer can conscientiously say to an indefinite distance, and he would be fully prepared to figure out, and contract for, if necessary, the fulfilment of his statement, but it rests with the commercial men to cry halt. The distances attainable, however, on a profitable basis, have been growing greater from year to year, as the manufacturers have been prepared to extend the limit to which they are willing to build high tension apparatus. At present it would appear that where the distance to be transmitted is over 75 to 100 miles, no matter how cheap the hydraulic development, commercial competition is not practicable with existing power where coal can be obtained for $2.00, $3.00 or even $4.00 per ton.

The step-down station and the distribution of power are the next items of expense, including the cost of the necessary switchboards, transformers, &c.

The location of the step-down station and the method of the distribution of power constitute a very important question. Unfortunately, very often this subject is entirely omitted or overlooked by the promoter, but is one to which should be given considerable thought.

The step-down station itself should be centrally located, so as to make the distributing lines as short as possible.

It is not generally advisable that transmission lines of very high voltages and large currents be extended through thickly settled communities where they might be liable to disturbance from fire or accidents of similar character, in the immediate locality of the line. In some places, to enable the distribution station to be centrally located, transmission wires are placed in conduits under ground, when they pass through thickly settled districts so as to avoid the danger that would otherwise exist, but this, of course, is expensive construction, and the cost of it must always be balanced against the advantages of having the step-down station centrally located, as against its being placed at the outskirts of the town.

All the various items require careful study to obtain least cost and avoid unwise economies.

When all these various factors have been properly adjusted and the resulting condition of the water power electric plant is that the power available twenty-four hours every day is at or about the cost of steam power in any given locality, the future profitable operation will be, no doubt, assured, because the popularity of electric power is not due alone to the fact that it can be produced cheaper than power obtained from other sources, but also to its superiority in other directions. This is evidenced by the fact that in mills and factories, where both sources of power have been tried, electric power is displacing the steam plant. Owners having experience with both invariably state that they would not be willing to return to their former power plants, even if power could be produced as cheap or cheaper than they are now obtaining it for electrically. The reasons for this are very numerous. The power is always on tap day and night, year in and year out; there is no waiting for boilers to be fired, nor shut-downs on account of strikes at some distant coal field ; less room is required, and consequently floor space formerly occupied by belts and shafting can now be utilized for manufacturing purposes; also electric power can be easily sub-divided into any number or sizes of units, and thus independent departments and machinery can be worked separately instead of from one big unit.

Overtime work in any department is much cheaper, for by having departments separately operated they can be run independently at will, without running all the other machinery in the mill. The fire risks are less, and rates of insurance less for mills operated electrically than by other means.

Removal of so many belts, line shafts, pulleys, etc., secures less danger to life of mill employees, and the mill is lighter and cleaner, and consequently the health of operatives better.

On account of the extreme simplicity of the A.C. electric apparatus, anybody with ordinary intelligence can start it in motion, and thus avoid depending on one or two men.

Moreover, with electric power it is possible to maintain a closer speed, which in many instances enables the turning out of a larger quantity of better product commanding higher price ; and so on for most every department and branch of business, some advantage is gained without anything lost.

All of these advantages are not evident to the consumer before or when he first puts in electric power, and he often refuses to listen to them, thinking that they are entirely imaginary, but a short experience brings the conclusion that electric power is "cheap at any price."

It may be interesting to note here that there is a project now on foot in which it is contemplated to transmit 30,000 h.p. a distance of between 30 to 40 miles ; the transmitted power to be used in mills now operated through shafts, gears and belting by water wheels, because of the advantages to be gained by using electric power.

The use of electric power is not confined to driving machinery in mills or factories, for it is fast finding its usefulness in other directions. The use for "electro chemical" enterprises is fast reaching vast proportions, and there are plans now on foot for the utilization of at least 150,000 h.p. in this way during the next two or three years.

There are many thousands of h.p. being used in the street railways, while the big trunk lines are seriously considering its use, and are continually asking the manufacturing companies for plans and estimates.

Then there is the electric welding, the electric plating, the supplying of energy to horseless carriages and electric launches, to say nothing of the hundreds of thousands of incandescent and arc lamps that are used for general lighting.

The utilzation of the water power by electric transmission has not stopped with the commercial world, but has forced itself into the privacy of our own homes, not merely with incandescent lamps, but with electric cooking utensils, smoothing irons, electric heaters, fan motors, etc.

What would our forefathers say if they were told that to-day we are depending on such and such a river, so many miles distant, to cook our meals for us and to have our boiled shirts laundried ; but we would better not laugh now, for the coming generations may have as much occasion to laugh at us.

HOW TO OVERCOME SOME OF THE DIFFICULTIES ENCOUNTERED BY CENTRAL STATION MEN.

By A. A. Wright, Renfrew, Ont.

In treating this subject I shall do so from the standpoint of one who has to deal with customers living in a town of moderate size, and not from that of the owner of a plant in a large and populous city, because the circumstances would be, in many respects, quite different, and the requirements, as well as the mode of arranging the service, would be altogether different. I shall take it for granted that the central station is equipped with an arc and incandescent plant, that the proprietor not only does commercial lighting, but supplies light to the corporation as well.

1st. Let us take up arc lighting on the streets. This brings us at once into contact with the corporate fathers, many of whom know nothing of arc lighting, except that it is not only necessary, but their special duty, to appear wise in order that they may look well after the interests of the town.

And now let me make my first suggestion, and that is, that you leave municipal politics entirely alone. If you have an inordinate craving after politics, which you have not the power to restrain, let your light shine before the throne of the Legislative Assembly or in the chamber of the House of Commons, but restrain yourself from meddling with municipal politics, lest you make to yourself enemies who will be sure to avenge themselves, sooner or later, in crippling your lighting contracts with the corporation. I do not wish you to infer from this that you should not exercise your franchise when the day for voting comes around, but on the contrary, let it be known that you and your employees always vote for the progressive and enterprising men of the town and as every aspiring alderman will want your assistance, you if you do not make too much noise, will generally manage when he is elected to get his. Be careful not to make political enemies but to have as many of the town authorities with you as you possibly can. In most towns the contracts for street lighting are made annually, and not as in cities, for a term of years. See to it then, that your contract is so arranged that it shall terminate on the 1st of March. You can do this by informing the proper authorities that your books are so arranged that your Electric Light year begins on that date. Then see that the following harmless looking saving clause is inserted near the closing part of the contract. "And it is further agreed that either party may terminate this lease at the end of its term by giving the other thirty days notice in writing prior thereto and in default of such notice this agreement shall continue in force after the termination thereof, for one year, and upon the same terms and conditions as are herein expressed and in like manner thereafter, unless such notice is given at least thirty days before the corresponding date in each succeeding year, a like renewal and extension of this lease from year to year shall be considered as made and executed by and between, the parties hereto." Furthermore have your payments fall due quarterly and on the 1st of March, June, September and December. You know that in Ontario at least, our Municipal Elections are held at the beginning of the year, and as most of the Aldermen will be aspiring to re-election, and would like to have your assistance to re-elect them, they will quite naturally forget, as the term of their holding office is drawing to a close, to give notice of the desirability of terminating that contract, and you almost invariably escape that threatened danger from the outgoing council. Then the new council does not assemble till the last of January and as very little business is done at the first meeting and many of the members are new ones, Electric Lighting is not thought of till your quarterly account is presented in March when it will be too late to give the required notice, and so your contract runs on, in this manner from year to year, renewing itself without any trouble whatever. Another difficulty, which you are almost sure to encounter, is the height of the poles on which your lights are placed on the streets. Some will want 50ft. poles some 75 ft. and some even higher than either of these. When your contract is made be sure and have the clause worded in this way. "That the hangers from which the lamps are suspended shall be — feet from the natural level of the surface of the ground at the foot of the pole," and not, that the lamp, shall be so many feet high, as you will notice that this makes an important difference in your favor. It is well to have it so arranged that you need not run your arc plant on moonlight nights, not merely on account of the direct saving that there is in this, but it sometimes is very convenient, if there are accidents, in giving you an opportunity to make needed repairs.

And now as to your commercial lights. Have your contracts made with your customers on a yearly basis, with same renewing clause that there is in your contract with the town, but with this difference, that the payments in this case be made to you weekly, and then see to it, that you make your collections in this way, for a man will frequently pay you a small sum weekly, when he would not pay the same amount if paid quarterly. It may not be amiss to mention that in all these contracts, when stating the candle power of the lamps you are to furnish, that you should be sure and employ the words "nominal candle" power, as it may save you under certain circumstances no small amount of trouble also.

And next, as to your incandescent service. This will, of course, be largely, if not entirely, a commercial service. You will have all manner of people to deal with, and you may expect, in many cases, to have your patience sorely tried.

Then to begin at the beginning. Never under any circumstances do free wiring. By that I mean that you should never undertake to wire a house for nothing, in order that you might thus get a customer for your current. Of course you should do all primary work as low as possible, but not at a loss. If your power is at all limited, or if you run by steam, you will find, in my opinion, that you will make more by running your lights on the meter system than you will by giving a flat rate, unless you get an exceptionally good price for them.

I understand that in many places it is customary to take the readings of your meters quarterly, as it thus saves a good deal of time in taking the readings, making out the accounts, collecting them, etc. In this, as in other things, the old adage holds good that "Short accounts make long friends," and by no means should you allow your accounts to pass more than one month without being rendered, and, if possible, collected. It might not be so bad, in the short nights of midsummer, if quarterly collections were adopted, but in the end it will amply repay you to take your readings on the first day of each month, and make your collections on the 2nd.

And now as to the location of your meters. We were instructed when installing our plant to locate them in some out-of-the-way place, where they would not be seen, and high up, so that they would not be meddled with. Now this may all be very good advice in its way, but my advice to you is, not of course to put it in the parlor, or in such a place as to cause it to be an objectionable feature in the household, but, be sure and place it low enough, that your man can get at it with as little trouble as possible, and also in a place where there is an abundance of light, so that the readings may not only be taken quickly, but accurately. When you have a large number of readings taken monthly, it becomes a matter of some moment that meters be so arranged that the work can be done quickly and accurately as well. You will be frequently told by your customers that the meter is wrong—that they know they never burned that amount of current. In such pronounced cases as these, when the assertions are very strong, I find it is better at once to say, "Well, it is possible as you say that there is something wrong; you know we are none of us infallible; we will see and have a second reading made at once," and look into the matter and at once, do as you have promised, no matter though you feel almost sure that it is all right. You may find that there is an error, and if so you should of course immediately see that it is corrected, but if you find that the reading is correct, and that Mrs. Julius Caesar still insists that that meter is no good, and declares that the thing runs whether there are any lamps on or not, and tells you in a most emphatic manner that she can hear the thing sing like a rattlesnake, lights or no lights, and she knows that it runs on wheels, what then? Above all things do not allow yourself to answer back harshly, for doubtless she really is sincere in her protestations, and it is not wise to contradict her too rashly. I have found a good remedy in replying that of course it is just possible that the meter is not absolutely correct, but that you feel quite confident that it is, and that to cover just such cases as these the government has appointed an electrical expert, to whom both parties can appeal, and if she, after considering the matter over, still thinks there is something wrong, that you will write and have the inspector come up and examine the meter, and if he finds it wrong, that you will bear all the expenses connected with the inspection, but if it is correct that she is to bear all expenses. Tell her just to think the matter over and let you know, and so far as my experience goes that ends the matter.

Another difficulty that you will doubtless meet when running on the meter system is in having your customers send out of town for 5 c.p. lamps and when only one of these is used your meter will not respond. This you will easily discern when at the end of the month you perceive that no current has been consumed, and I may just here mention that this is another reason for taking your readings monthly instead of quarterly. Such cases are not numerous, yet they do turn up where the family is small and its members are contented to do with a minimum of light. This difficulty can also largely be overcome by making a minimum rate of say 50 or 75 cents per month, which amount can be arranged according as the circumstances of the case may require.

There are of course many other difficulties that central station men have to deal with, but it is impossible to consider many in an article of ordinary length and the remaining ones will be left for others to treat with, as they, in their wisdom, may see fit.

THE IMPORTANCE OF PROPER METHODS OF ILLUMINATION.

By F. A. Bowman, A.I.E.E., New Glasgow, N.S.

In the last few years, since the electricity supply business has got beyond the stage of "systems" and controlling patents, there has been accumulated a great deal of most valuable information in regard to improvements in the generating and distributing plant, and to the best methods of realizing in practice the benefits from these improvements. From time to time there have arisen most animated discussions on the best system of rates, and methods of charging for the use of the current. The keynote of these discussions is the fact, brought to light by the accumulated experience of those companies that have been supplying electricity for some years, that the fixed charges grow steadily with the maximum demand on the plant, and that therefore the customers should be educated to use the current as many hours per day as possible. This is a matter of the most vital importance, and every central station man in this Association should procure a copy of Mr. Arthur Wright's paper on "The Profitable Extension of Electricity Supply Stations," read before the National Electric Light Association at Niagara last year, and also one on the "Cost of Electricity Supply" read by him before the Municipal Electrical Association in England, and to study them until he knows them by heart.

It should be distinctly borne in mind, especially by the smaller companies, that to do a growing and really successful business, something more is necessary than to merely induce your customer to put in so many lamps and then to get as much pay as you can from him for them. It is now clearly demonstrated beyond a peradventure that the margin of profit is as narrow in the central station business as in any other, if not a great deal narrower, and that even when there is no competition from gas or a rival company the closest economy and best management are necessary to yield a profit to the shareholders and provide for future contingencies. In view of this the manager should realize that he must educate his clientele and give them the best satisfaction in every way. Too many managers are satisfied when they have succeeded in persuading a customer to take a certain number of lights. If in addition they are giving full pressure at the lamps and a reliable service they consider that their duty to both the company and the public is done. Now, this is a wrong principle. Attention should be paid to the purpose for which the light is required. Take for example a shop. The purpose for which it is to be used, its size, the height of ceiling, finish of the walls, kinds of goods to be displayed and sold, arrangement of counters and show-cases—all must be noted and considered. It is useless to attempt to light a modern drug store and a ready-made clothing store in the same way, and expect equally satisfactory results in both cases. The manager should be looked upon as an authority on methods of lighting, and if he gives the matter a reasonable amount of attention he very soon will be. He must remember that he is a dealer in light, and to be a successful one must know all about it—how it is best used and what are the latest fashions in it. If you go to a tailor for a suit of clothes you expect him not only to sell you the cloth and to make up the suit so that it will fit you fairly well, but you expect him to be able to tell you what are the latest styles and fashions and which of them are best adapted to the purpose for which you want them. Some managers will say, "Oh, I have a class of customers who do not care about fitting up nicely and will not spend money on it. All they want is that I will run the wires in and hang the lamps on cords as cheaply as possible." This man is mistaken. There is no community that will take electric light at all where a decided amount of education cannot be carried out. Education of his customers is a very material part of the work of every successful manager in the electrical business, and is one of the principal reasons why the business cannot be properly carried on by some one who has a number of other interests to look after as well. The manager must study this question of proper illumination so as to master the main principles necessary to a clear understanding of it. He must study his customers so as to know what their tastes and requirements are. He must carefully watch the advertisements in the technical journals and the catalogues that are so plentifully distributed, and many of which contain accurate and valuable information, and then correspond with the advertisers to see if the articles that strike him as suited to some of his customers can be brought within their reach. Then he must canvass carefully and patiently, and if he fails one year must try again the next, because by that time he will know better how to work, his customers' ideas will have advanced somewhat, possibly prices will have dropped a little. The net result of all this is that he at last secures a contract for fitting up that is a pleasure to him to undertake and gives eminent satisfaction to the customer when done.

When first installing lights in the smaller towns and villages cheap, but not poor, work must be done to get the light introduced, but it should be looked upon as introductory only, and later on an earnest and continued effort be made to weed it all out.

A very common case that arises is that of a customer occupying a shop who is always making trouble about the bills. He has a certain number of lights strewed about without any definite arrangement, one switch to shut off the whole thing when he leaves, no shades, no reflectors, and the shop is half dark when all the lights are on, and if he is on meter and turns off a few to save money he has not light enough to do his work. The result is he is constantly growling himself and making others do the same.

When a case of this kind comes up the manager should go to him and suggest that by rearranging things he can have better satisfaction for less money, talk the matter over and work out a scheme that will put the light just where it is wanted, and add a few switches so that the groups of lights can be readily turned on and off. After the exercise of considerable tact and unlimited patience the customer will begin to be convinced and finally consent to refit. When this is done and the lights placed just where wanted, very possibly lamps of smaller candle power than before can be used on some of them. The result is a well lighted shop, which is a good advertisement for both the customer and company at a somewhat reduced cost to the customer and satisfaction all round.

The fewer lights the customer can install and yet get satisfaction from, the longer hours he will burn them all, and so tend to smooth off the peak of his individual load line. And the cheaper he can do it while still yielding a profit, the better for the company, as he is an advertisement and attracts others. Five customers each of whom has ten lights and uses them all three or four hours each night, are better than one with fifty lights who uses them all for one hour and then turns off as many as possible.

It must be clearly borne in mind that the candle power of a lamp and the amount of illumination we get from it are two entirely distinct things. The useful illumination is the amount of light reflected back to the eye by the objects on which the light falls, and the quantity and quality of the light so reflected is the important and controlling factor, not the candle power of the source of light. The unit of illumination is the "candle-foot;" that is, a light of one candle power one foot distant from the object to be illumined. This is a comfortable light for reading. The illumination is given by the formula:

$$\frac{\text{Candle power}}{\text{Distance in feet}^2}$$

Thus a 16 candle power lamp 4 feet away gives 1 candle foot of illumination.

The illumination yielded by a certain lamp can be very materially increased by the use of reflectors. The illumination of an object which when below a small light is 1 can be increased to 23 by a paper reflector, to 30 by a white glass one, to 64 by a polished one, and to 260 by a silvered glass hemispherical one. White reflectors throw a very nice soft light and smooth off the edges of the shadows so as to produce a very pleasing effect. In using them it should be remembered that the ordinary law of reflection of light, viz., that the angle of reflection is equal to the angle of incidence does not apply to them; but that the rays of light at whatever angle they may strike the reflector spring off from it in lines perpendicular to its surface. Consequently there should be no attempt at the mathematical shapes of optical reflectors, but large flat surfaces must be used. They should always be painted a dead white. The enamelling of reflectors to have a shiny surface is a mistake: they do not give as good an effect to begin with and even the best rapidly lose their gloss.

The following table, due to Dr. Sumpner, gives the reflecting power of various surfaces and shows what a wide variation in the number of lights required for a given illumination may be caused by a change of interior decoration:

White blotting paper	82	per cent.
Ordinary foolscap	70	
Newspapers	50-70	
Yellow wall paper	40	
Blue paper	25	
Dark brown paper	13	
Dark chocolate paper	4	
Plain deal (clean)	40-50	
〃 (dirty)	20	
Yellow painted wall (clean)	40	
〃 〃 (dirty)	20	
Black cloth	1.2	
Black velvet	4	〃

When studying out the lighting of a given place we must consider whether we merely wish for a general sense of the space being nicely or brilliantly lighted, as in a ball room or dining room; or whether particular spots or objects need to be clearly illuminated, as the goods in a shop or the tables in a library.

The most important step to good illumination is to secure to the utmost extent possible that no bright spots or lines of light shall strike the eye. The moment the eye sees the source of light it closes itself up for protection from the direct rays and consequently cannot receive as much of the light reflected from neighboring objects, and therefore does not see them distinctly. The following experiment will illustrate this very clearly: Take a shop with two show windows and hang the lights in one window about the level of the eyes, as is so commonly done, and in the other put the same number of lights in good reflectors close up to the ceiling. Now go across the street and note the result. In the first window the goods on exhibition are fairly well lighted, but it is a discomfort to look at them long and nothing is seen behind them. In the other window the goods are shown up beautifully and you can look at them as long as you wish and at the same time can see right back into the shop and see the goods on the shelves and counters.

In the smaller towns and in many cases in the larger ones the question of getting exactly the best illumination and effect from the lights must be subordinated to that of the cost both of the fitting up and of the current consumed. Also a certain amount of deference must be paid to the ideas of the owners.

Thus in lighting show windows the very best method is to light them from overhead, or from the corners, with lamps in deep and powerful reflectors that will throw the light directly on the goods to be shown and will shield it from everywhere else. If it is necessary for the proprietor to be as economical of light as possible this can hardly be done as these lamps are useless for general illumination in the shop. In such a case as this clusters under good flat reflectors on the ceiling of the window are best. These show the goods in the window very nicely, they make the front look much brighter, and at the same time throw a very considerable quantity of light into the front part of the shop where it is most required.

An exceedingly common case is a shop from 20 to 25 feet wide, 40 to 50 feet deep with two show windows, the ceiling being from 10 to 12 feet high, and used for dry goods, tailoring, groceries, etc. A very good arrangement for this is to put a three-light cluster and flat reflector in each window, and three similar three-light clusters down the centre of the shop. The main switch should be placed at a convenient spot near the door by which the employees enter and will of course turn on all the lights. Another switch should then be arranged to turn off the window lights, and another to turn off two lights in each of the clusters in the centre. This will be found to be a most convenient and economical arrangement for the customer, who can proportion his light to the weather and amount of business doing. While the central station man will find that, if the shop is open in the evenings at all, the whole of the lights will be on long enough to cover the maximum demand, or standing charges.

These clusters should not be more than 10′ 6″ from the floor; were these lights raised to 15 feet the direct light from them would be reduced one half, calling for double the number to produce the same illumination, but since in this case the reflection from the ceiling and walls would be somewhat increased, probably an increase of 50 per cent. in the number of lights would be sufficient.

Drug stores generally call for very special treatment, and the lighting must be made to harmonize with and to show off the fittings. Brackets on the top of the shelving and a handsome electrolier in the centre are generally very acceptable, but as the result desired is more in the way of brilliant effect than of mere illumination for the showing of goods each case must be studied out to suit the purse and the tastes of the persons concerned.

In the matter of churches the great desideratum is the even distribution of the light, with absence of shadows and the total avoidance of all spots or lines of light that will strike the eye of the congregation, or of the minister, especially during the sermon. The minister, the choir and the organist of course require plenty of light, and it often calls for considerable ingenuity to supply their needs without having a bank of lights most unpleasant to the congregation. If such a group of lights cannot be avoided it should be provided with a switch within convenient reach so that it can be turned out during the sermon. In Anglican and Roman Catholic churches which have chancels separated by an arch from the main body of the building, the lights can often be arranged on this arch so as to be entirely hidden from the congregation and yet throw a very pleasant light on the choir and reading desks.

Lodge rooms should be well lighted, and as they are often finished in very dark colors this is a difficult matter. The lights should be divided into groups controlled by switches, and those at the desks of secretary and treasurer are often wanted to be independant of the others in the room. A dimmer is a valuable addition and should be arranged to control all the lights except those just mentioned. It should be a regular theatre dimmer of ample capacity. Lodges are not as a rule paying customers because their use of the light is irregular and the income per light from them very small. Nevertheless it pays to give a good deal of attention to the fitting up of them, because many get educated to good lighting through them whom it would be difficult or impossible to reach in any other way. It will require a good deal of work to get the first one well done and especially to get the dimmer introduced, but after that it will be comparatively easy.

EXPERIENCES OF AN INSPECTOR.

By J. K. Johnstone, Inspector of Electric Lights, Toronto.

When honored by an invitation from the Executive to prepare a paper for the Society, I was somewhat in doubt as to the choice of a subject. I wished to furnish something that might be of interest to you and at the same time to avoid any of the important branches of electrical science which might leave me liable to criticism from gentlemen so highly qualified; hence, with your kind permission, I will confine myself to giving you a few impressions as received in my capacity as inspector.

At the introduction of the government inspection of electric lighting, there were a few, as you may remember, opposed to the act, and I acknowledge that it was with some misgivings that I went forth on my duties. However, it is with pleasure that I can now recall every visit made to the electric light stations in my district, and in every instance have I not only been kindly received, but every suggestion of improvement offered by me has been acted upon immediately and with evident pleasure. I need not tell you that in not one instance have I found any attempt on the part of electric light companies to defraud their customers, although occasionally appealed to by consumers on that ground. An investigation usually resulted in discovering old lamps, too few lights for the space lit, wastefulness where a meter was in use, or some other fault in the power of the consumer to correct.

The persistence of many purchasers of electric light in clinging to old and useless lamps is a common source of annoyance to the companies and a difficult matter to overcome. The old lamp is often expected to give as brilliant a light as when first installed, and when unable to do so the charge is frequently made that the company supply a too low voltage. To please these grumblers, a mistake is sometimes made in endeavoring to supply a current sufficient to brighten these worn-out lamps, and this, too, at the expense of new lamps, whose brilliancy is thus deteriorated. As it is impossible to compel the purchase of new lamps, and as the companies are anxious to please their customers, I have suggested, when consulted, that new lamps should be supplied at their actual cost, thus throwing the blame on the consumers when their lights were poor, economizing electric current and sparing new lamps.

The question as to the advisability of using meters, where practicable, can only be answered in their favor. By the employment of a meter a just system is accorded to manufacturer and consumer alike; the wasteful man is made to pay fairly for his neglect, while the careful and honest man is charged only for the light needed and current consumed. Under the flat rate system, it is not uncommon to see large shops brilliantly illuminated throughout the entire night. Managers tell me that it is difficult to introduce the meter where flat rates have been charged, but, despite the objections, many are making the change. The several types of dial registering meters which I have inspected are usually accurate, and I am told prove satisfactory as measuring instruments for either power or light.

A lack of uniformity in rates, both by meter and flat rate systems, has been a subject of complaint with some managers. There is evidently no remedy for this unless an arrangement can be arrived at by the manufacturers themselves and a standard charge agreed to.

In several towns in the district visited by me a system of street lighting by incandescent lamps has been adopted. When properly arranged the appearance is quite pretty and the light well distributed.

In concluding, permit me to tell you that the managers and electricians I have met in my work are without exception kindly and intelligent men, and in this favorable opinion I am borne out by other inspectors with whom I have spoken upon the subject. It has been suggested to me that there may be some potent and subtle charm in the electric current which develops the best qualities in a man's character. Can this be so?

THE UNCONSCIOUS OWNERSHIP OF AN IMPORTANT KEY.

A Plea for the Introduction of Goods Traffic on Our Suburban Tramways.

By W. T. Bonner, Montreal.

The first consideration in exploiting any new suburban tramway is the possible or available passenger traffic. That being found inadequate to guarantee a fair return on the cost of installation and maintenance, the project is usually abandoned for the reason that only passenger traffic can be considered, owing to the high cost of handling goods traffic at the terminals. While a motorman and conductor are sufficient to handle a two or three-car electric train for passenger traffic, with very little expenditure of time or assistance for loading and unloading, all railways under present systems require a large additional force to conduct the hundreds of details attending the reception, checking, loading, transferring, unloading and proper delivery, in good order, of either car lot or package freight.

It is not the railway investors alone who suffer the effects of this handicap, but the property owners also, since the latter have no recourse, while the capitalist has but to seek other more profitable fields for investment.

It may therefore be conceded that the whole subject presents two phases of commercial economy, viz.:

(a) From the standpoint of the agriculturalist and land owner; how best to provide a means for increasing the value of remote but otherwise valuable agricultural lands, and at the same time retain present value of adjacent property by converting it from market gardens into residence and manufacturing sites.

(b) From the standpoint of the capitalist and manager of railway properties; how best to increase the earning capacity of existing or proposed suburban lines.

DEPRECIATION OF FARM LAND VALUES.

With the ever increasing centralization of population and commerce, inaccessible property becomes less valuable; all land, whether barren or fertile, suffering alike, according to its distance from the centre of demand for farm products, which we call markets. Such distance is not always measured in actual miles, but rather in accessibility, since in our day we find frequent examples of the paradoxical long and short haul rates. The Minnesota and Manitoba farmers will deliver their wheat at the seaboard at a lower cost per bushel than the farmer who may live a hundred miles off the coast. The eastern farmer may have just as fertile land as his western competitor, but he is handicapped by having to haul his wheat forty or fifty miles over poor wagon roads to reach the nearest railroad.

In either case, the terminal charges, including the cost of loading the produce at the farm, is approximately the same, but the difference in cost of haulage per ton-mile by railroad and wagon road is so tremendously in favor of the former that without such facilities the farmer may as well retire from business. It has been stated as a fact that to transport a ton of coal from Buffalo to Chicago costs no more than to move the same quantity of coal across the sidewalk in either city.

In a late number of the Marine Review some interesting comparisons were made between the present cost of shipping coal to the Northwest and prices which obtained previous to the introduction of modern vessels and automatic coal handling machinery. Car-dump machines can now load four thousand tons in ten hours, as compared with two or three days under old methods; and coal is now carried from Lake Erie ports to the head of Lake Superior at twenty cents per ton, as against fifty cents, which was considered a ruinously low rate a few years ago.

It is frequently asserted that since the introduction and development of steam railways, they have gradually superseded the earlier methods of transportation and traffic, and as a consequence highways are no longer an indication of progress. This is true only to a limited extent. Railroads have changed the character of suburban traffic, and personal travel is no longer dependent upon the condition of the highways, but commercial intercourse, as represented in the exchange of products, is as much dependent upon the condition of the public road to-day as it ever was, for the reason that it is impossible to construct a railroad to the door of each producer and consumer. Hence railroads can never entirely supersede the common road, and every ton of freight carried by them must be conveyed over a highway at either or both terminals, and the cost of this highway transportation has a marked influence, not alone upon the price paid by the consumer, but also in the profit realized by the producer.

Few people have any knowledge of the real cost of transportation by horse and wagon, or comprehend the amount of money expended needlessly every year through failure to provide proper roadways and modern tramways.

The following table shows the results of actual observations on the cost of moving a load of one ton a distance of one mile on level roadways, with different pavements and under average conditions:

TABLE I.

COST OF TRANSPORTATION BY HORSES AND WAGONS PER TON-MILE ON DIFFERENT SURFACES.

Iron Rails....	1.28	cents per ton-mile.
Asphalt	2.70	" "
Stone, paving, dry and in good order	5.33	" "
" " ordinary condition	12.00	" "
" " covered with mud	21.30	" "
Broken Stone, dry and in good order	8.00	" "
" " moist and in good order	10.30	" "
" " ordinary condition	11.90	" "
" " covered with mud	14.30	" "
" " ruts and mud	26.00	" "
Earth, dry and hard	18.00	" "
" ruts and mud	39.00	" "
Gravel, loose	51.60	" "
" compacted	12.80	" "
Plank, good condition	8.80	" "
Sand, wet	32.60	" "
" dry	64.00	" "

The comparative cost of transportation over rough roads may be estimated from Table No. 2, which shows with sufficient exactness for most practical purposes, the force required to draw loaded wagons over inclines. This table shows the force exerted by the load in its downward tendency, as well as the force required to draw it up grades of various inclinations; also maximum duty performed by an average horse, weighing, say twelve hundred pounds, the friction of the surface being taken at one-fiftieth of the load drawn :

TABLE II.

Rate of Grade. Ft. per 100 ft.	Pressure on the plane in lbs. per ton.	Tendency down the plane in lbs. per ton.	Power in lbs. required to haul one ton up the plane.	Equiv. Length of level road miles.	Max. Load in lbs. which a horse can haul.
0.0	2240	.00	45.00	1.000	6270
0.25	2240	5.60	50.60	1.121	5376
0.50	2240	11.20	56.20	1.242	4973
0.75	2240	16.80	61.80	1.373	4490
1.	2240	22.40	67.40	1.500	4145
1.25	2240	28.00	73.00	1.622	3830
1.50	2240	33.60	78.60	1.746	3584
1.75	2240	39.20	84.20	1.871	3290
2.	2240	45.00	90.00	2.000	3114
2.25	2240	50.40	95.40	2.120	2935
2.50	2240	56.00	101.00	2.244	2725
2.75	2240	61.33	106.33	2.363	2620
3	2239	67.20	112.20	2.484	2486
4	2238	89.20	134.20	2.982	2083
5	2237	112.00	157.00	3.444	1800
6	2233	134.40	179.40	3.986	1568
7	2232	156.80	201.80	4.844	1367
8	2232	179.20	224.20	4.982	1235
9	2231	201.60	246.60	5.480	1125
10	2229	224.00	269.00	5.977	1030

From the foregoing tables, and from statistics gathered by both state and national bureaus, it has been calculated that the average cost of transportation by animal power is twenty-five cents per ton per mile. Furthermore, the rate of transportation by animal power is, and always has been, excessively high, and the evidence of all statistics, both ancient and modern, shows but slight improvement as compared with the progress made in other departments of industry, and by other means of transportation. It being true that the value of land and wages of labor are affected by the cost of transportation, we should expect to find that where so high a rate as twenty-five cents per ton-mile prevails, the land would diminish in value, and the rewards of labor bestowed upon such lands would grow less and less. What we expect to find, we do find.

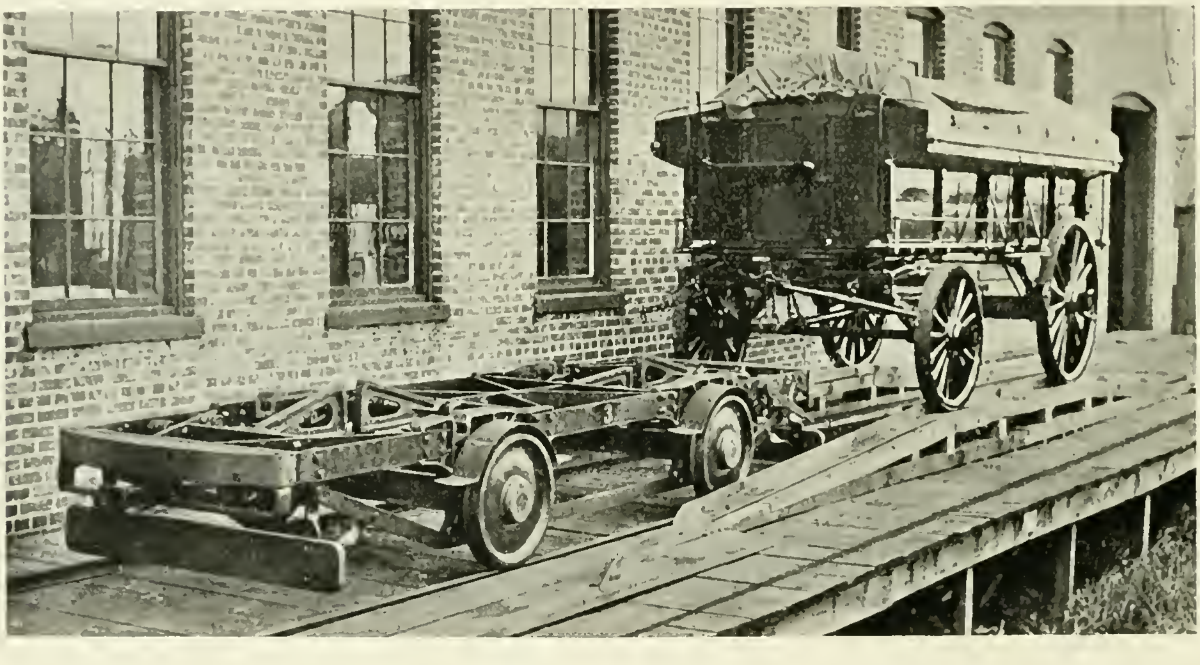

FIG. 1.

A forcible illustration of this fact was brought to the writer's attention a few days ago. A resident of Long Island, living about fifty miles out from New York city, owns 500 acres of as fertile land as may be found anywhere. Although beautifully situated, and with every natural advantage to favor production, the cultivation of all staple products has been abandoned by him owing to lack of proper transportation facilities. With potatoes jobbing at eighty cents to one dollar per bushel in New York, he was compelled to sacrifice his entire crop, giving away hundreds of bushels, rather than allow them to rot in his cellars.

It is not necessary for the careful observer to rely solely upon official reports for information, for the above is but an every-day example of the result of excessive cost of transportation, the ever-decreasing price of inaccessible land, and the diminished rewards of labor bestowed upon it. The price of land and the value of labor decreases in almost inverse proportion to the distance over which the agricultural products must be transported by horse power.

One fact is patent to all, that whereas formerly the distribution of population was approximately equal over the face of the country, it is gradually becoming concentrated into large cities to such an extent that already fully one-half of the inhabitants of the older sections of the country live in cities. The evident reason for this is competition, the demand for increased output at reduced cost. Concentration indicates increased power for production. Take, for instance, some of our commonest staples, like wheat, beef, pork, molasses, wagons, horseshoes, butter and clothing. Within the writer's memory, these articles were produced at home, or in small shops and factories distributed, like the population, quite equally throughout the country at cross-roads and villages, utilizing crude methods and operated by the old-fashioned treadmill or horse power, and overshot water wheels. The output of flour per man per day in those mills did not exceed ten barrels. At the great Winnipeg and Keewatin mills and at Minneapolis the milling business has been so concentrated that to-day the output per man exceeds one hundred barrels and the cost of production is correspondingly reduced. But of what benefit to inaccessible property in the interior is this reduced cost of production, unless like facilities for transportation are afforded?

The measure of benefit which any improvement in production in one community bears to another community, depends entirely upon the transportation facilities between the two places. Recently a customer came into our office from one of the interior mining districts. We estimated the plant he required would cost $1,255. To help him out all we could, we eliminated every possible item not absolutely essential to the proper working of the plant, and allowing also for erector not being required, we found we could reduce our price 10%, making the net total $1,130. But how insignificant our discount appeared when we learned the freight from Montreal to the mine would cost $1,248, notwithstanding no part of the route required mule-back transportation. Although further distant from Montreal, the same plant could be transported to Vancouver for less than $250.

Concentration of population and production requires for the better equilization of supply, and price of materials and provisions, that such centres must be provided with commercial veins and arteries which shall quickly and cheaply transport or exchange urban and suburban passengers and commodities. While long haul rates of transportation by railroads and steamships have been wonderfully cheapened, there still remains a space of fifteen to twenty-five or even forty or fifty miles surrounding every commercial centre, which has never been covered by any cheap method of transportation. Such distances are beyond the possibility of cheap or efficient service by animal power, and the terminal charges and bulky plant required, precludes any possibility of much reduction in railroad tariffs. What we require therefore is a new system of transportation which shall be alike available for freight and passengers.

The problem of handling exclusively passenger traffic is comparatively simple ; indeed it has already been solved for those districts where the population is sufficiently dense to support steam or electric tramways requiring no other source of revenue. Experienced railroad men are unanimous, however, in agreeing that no road, whether steam or electric, will pay in a thinly settled district, unless assisted by a bonus or by the addition of freight traffic.

In this day of great competition capital is constantly seeking methods for reducing costs. Manufacturers calculate even the individual bristles required to make a brush, and the ounces of warp in a yard of cloth. An extra hair in a brush or an ounce of warp more than is necessary, does not amount to much in a single brush or a yard of cloth, but the savings in a day's output might make a perceptible increase in the dividend account. Cost of operation and maintenance are to-day the great factors in every commercial or manufacturing calculation. Capital is ever ready to supply the installation provided it can be insured a fair return on the investment.

This age has not only developed the mechanical and the electrical engineer, but to-day they are striving harder than ever to distance as far as possible the civil engineer whose development of the highway, the canal and the railroad, made him famous years ago. That the civil engineer has achieved wonderful results in the operation of steam roads no one will deny, but for the solution of the short haul problem we must eliminate his cumbersome trains, his extensive terminals and expensive equipment and service generally, before we can hope to approach the mean line of tariffs which shall re-establish the movement of commodities within every part of the short-haul circle. Then may we expect a more even balance of land values, and from the increased traffic will come substantial dividends to the investor in railway securities.

In 1894 the writer promoted a scheme for uniting one of the large commercial centres on Lake Erie with several surrounding counties by a system of electric railways which would combine both freight and passenger traffic. The arrangement was such that the farmers anywhere along the line would secure the immediate benefit of the higher city market rates for their produce, as well as competitive selection and prices for supplies. Local and sub-stations were to be established at frequent points along the line where the farmers could deposit their produce to be forwarded by next train to a central clearing house in the city from whence it could be delivered at once to the consumer. The scheme was to be co-operative in a measure, the subscribers to receive the first benefits. Telephone connection was to be established between the city and farm residences through the company's local stations, and direct orders for goods from the city merchant could be received by wire and despatched by next train out. Only samples, or a very limited supply of staple goods,

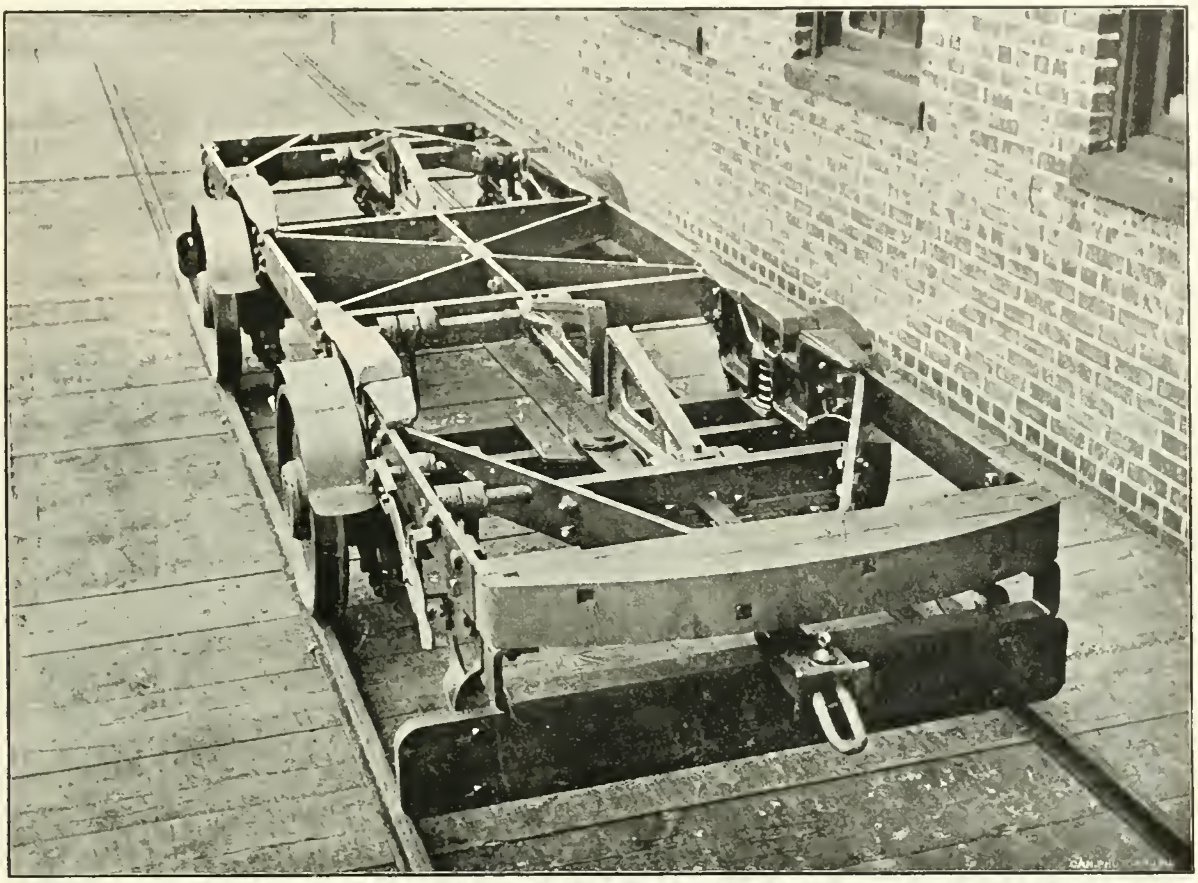

Fig. 2.

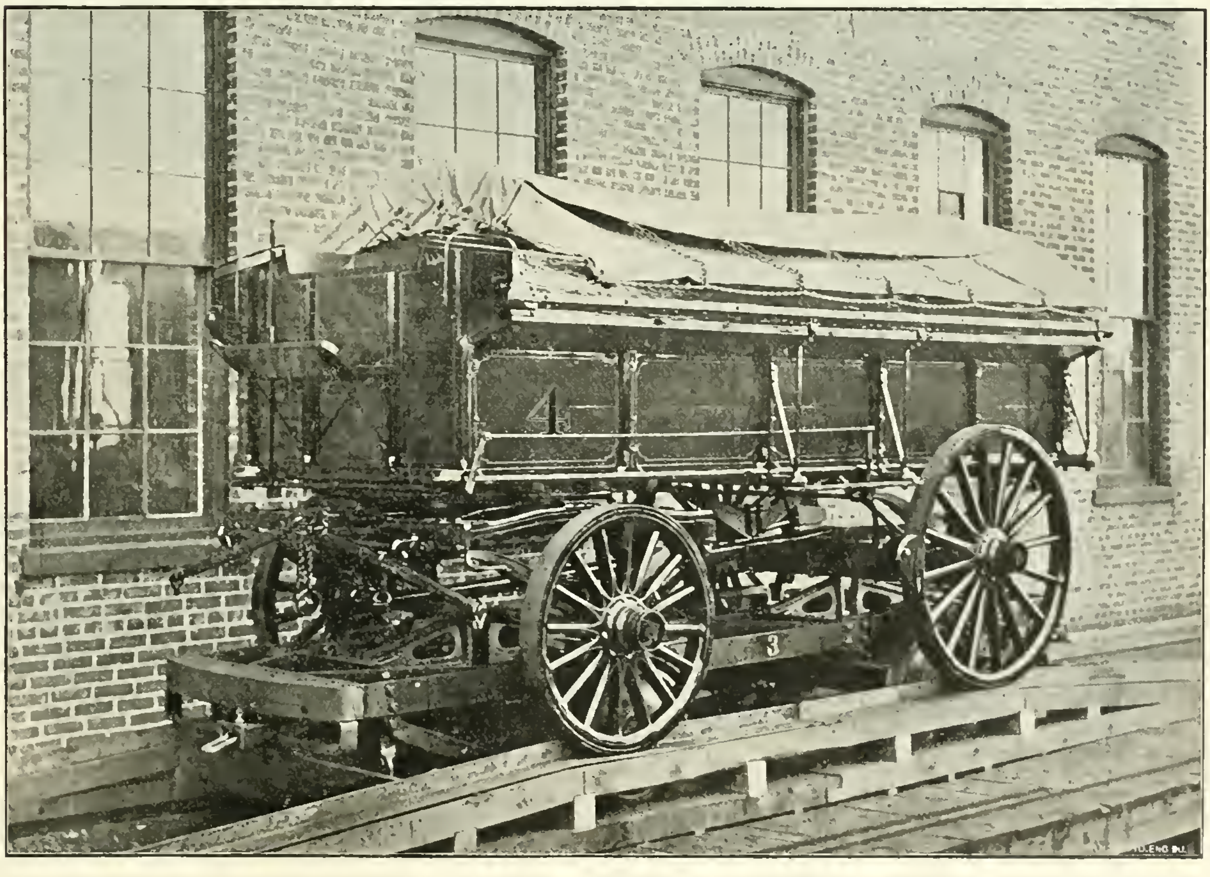

Fig. 3.

were to be kept at the local stations, the principal stock to be maintained at the central clearing house, and by the various city merchants who belonged to the syndicate. Electric current for light and power were also to be supplied to consumers along the line. In short it was proposed to so unite city and country by wire and rail that all would enjoy equal facilities for obtaining supplies.

Unfortunately the financial depression of that year so handicapped our efforts that we were unable to carry out the project, but those who gave the subject most careful consideration at the time still expect to see some such system as the above in general use.

The latest development in the line of providing for goods traffic on electric tramways came to the writer's notice some months ago in the shape of a combination vehicle, so constructed as to be readily convertible for use upon any ordinary roadway or upon a railroad track. It can be shifted from one to the other at will, without the necessity of reloading or rehandling the contents between points of shipment and destination. The idea is not altogether new, but the application will no doubt impress you all as novel in the extreme.

Notwithstanding the similarity of names the writer begs to disclaim any connection with the introduction of this scheme, but nevertheless the principle involved certainly commands attention.

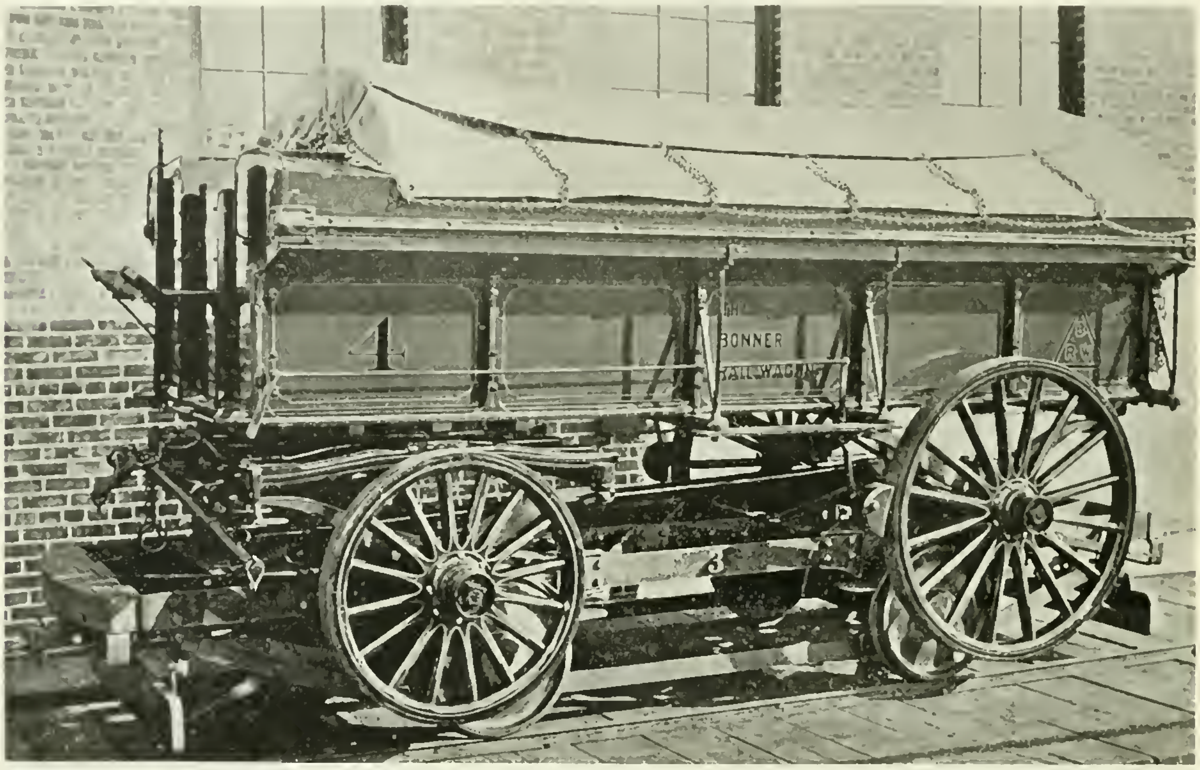

Fig. 4.

The Bonner Rail Wagon Company, organized about a year ago to develop the patents of Col. Jos. C. Bonner, of Toledo, Ohio, states in its prospectus that it will build rail wagons and operate them through leases or franchises granted to interurban electric railroads. It is proposed that such roads shall be equipped with any stipulated number of rail wagons, thus enabling them to supply patrons at any point along their lines, or at the terminal stations.

The general supervision and control will be vested in the Rail Wagon Company, thus relieving the local electric railways of the detail inspection and repairing, as well as freight contracting. The Wagon Company will contract to provide service as the traffic of the electric roads may require. The wagons will be neat and substantial and tarpaulin-covered at all times, whether loaded or not, after the same manner as the goods vans are covered on English and continental railroads. This provision permits sealing and also provides protection against exposure to inclement weather.

As an essential feature of this enterprise, the Rail Wagon Company will supply horses and drivers for service at terminals, thereby retaining in responsible hands, the execution of traffic agreements and establishing a direct-connecting link between the producer and the consumer. Agents will collect the freight charges, which charges will include delivery to consumer. The tariff rates, covering both freight and delivery, will naturally be much less than prevailing freight charges under old methods of transportation, since no allowance need be made for capital invested in expensive terminals or for maintenance of same.

Figure 1 of the annexed cuts illustrates the integral parts of the combination vehicle. The wagon proper is patterned after the ordinary improved road wagon, modified, of course, for the special nature of the service contemplated. The running gears and springs are of standard construction having a carrying capacity of from three to seven tons, depending upon the class of freight to be carried.

The rail truck is not materially different from the car truck in general use upon our electric railways, except that it is provided with special attachments for automatically gripping and supporting the wagon proper. The truck is exceedingly simple in design and very light in proportion to its strength, being constructed entirely of wrought iron and cast steel.

Figure 2 shows more clearly the detail construction of the rail truck and the arrangement of the cast steel segments or dogs, supported in place horizontally by heavy plate springs, and used for the purpose of engaging the axles of the road wagon as the truck approache from either direction.

Figure 3 shows the road wagon in position on the loading switch with rail truck underneath, the dogs engaging the axles, ready to pull ahead. As the truck is drawn forward on the level rail by the electric motor, the impact of the projecting dogs against the wagon axles also starts the wagon forward, and as the latter travels down the inclined switch track, the axles gradually settle into the notch provided in the cast iron journal frames.

Figure 4 represents the wagon mounted on rail truck standing on the open track ready to be coupled to a motor car, or electric locomotive.

Figure 5 illustrates a train of five wagons, drawn by a familiar looking electric locomotive en route across the country, while figure 6 represents several rail wagons side tracked in convenient market stalls, the commission agent or owner serving out the contents fresh from the farm.

The actual time required for unshipping the wagon from the truck for road use, and vice versa, is not more than would be required for coupling together cars in making up a train.

The weight of the combined wagon and truck is sufficient to insure perfect rail traction and the proportion between carrying capacity and dead weight averages about the same as the ordinary freight car.

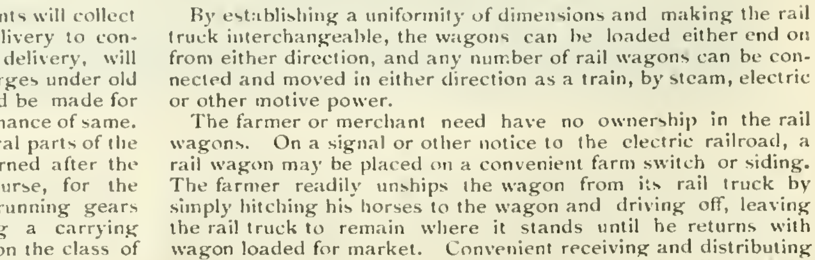

Fig. 5.

By establishing a uniformity of dimensions and making the rail truck interchangeable, the wagons can be loaded either end on from either direction, and any number of rail wagons can be connected and moved in either direction as a train, by steam, electric or other motive power.

The farmer or merchant need have no ownership in the rail wagons. On a signal or other notice to the electric railroad, a rail wagon may be placed on a convenient farm switch or siding. The farmer readily unships the wagon from its rail truck by simply hitching his horses to the wagon and driving off, leaving the rail truck to remain where it stands until he returns with wagon loaded for market. Convenient receiving and distributing stations can be located in the cities. Bulk merchandise can be handled; parcels, mail and express matter also, the rail wagon making store to store collections or deliveries. The movement of these rail wagons need not in any way interfere with passenger service of the electric railways, the heavy traffic being carried at night, when the electric lines and streets are least in use.

The great value of this novel method of handling goods traffic is readily demonstrated. Not only does it insure economy of time, labor and expense by avoiding reloading in transit, but the reduction in breakage which usually attends the shipment of eggs, glassware, pressed brick, or other fragile commodities, guarantees for it preference over other systems of transportation.

With these changed conditions of suburban traffic the greater part of the haul would be by rail, consequently the weight of the load units can be greatly increased. A team of horses can exert, for a short period, twice the average tractive pull which they would be able to exert continuously throughout a day's work, and, so long as the resistance on the incline is not more than double the resistance on the level, it follows they would be able to draw over short hills the maximum load they are capable of drawing along a level road.

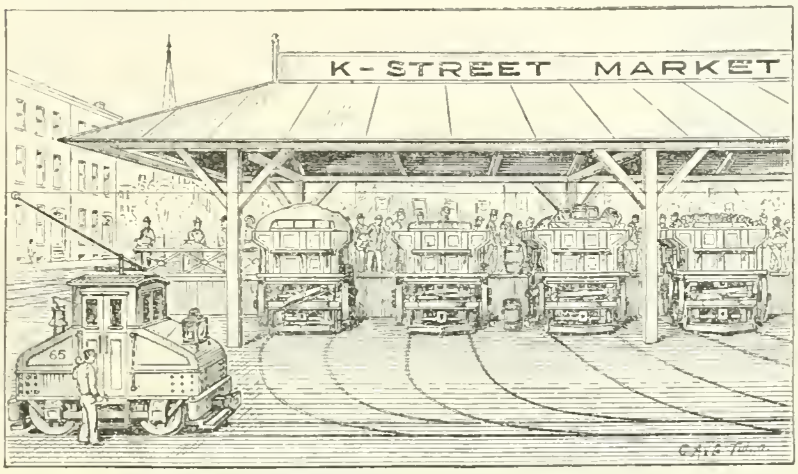

FIG. 6.

Such a system as the above would at once render accessible endless acres of fertile interior lands, and open them up to the systematic energy of the thrifty market gardener, the dairyman and the fruit grower. Improved conditions would result to the truck farmer, who would no longer he obliged to spend his night in long weary drives in order to reach the early market. Instead, his day's harvest would be transported to town during the night by electric rail wagon while man and horse refresh themselves in sleep.

Thus would we increase the market value of distant agricultural lands, and at the same time retain present values of nearby property. With the increase of land values and production, must also come increased traffic for existing or proposed suburban railways.

THE QUIMBY SCREW PUMP.

By W. T. Bonner, Montreal.

The probable increased demand for electric current due to the introduction of this new type of pump, which has entered the field of competition for commercial success within a recent period, should offer sufficient reason for describing it briefly in a paper for the benefit of this Association. The novel feature of the pump is its simplicity, utilizing as it does a very simple mechanical principle in a very unusual manner for performing useful work.

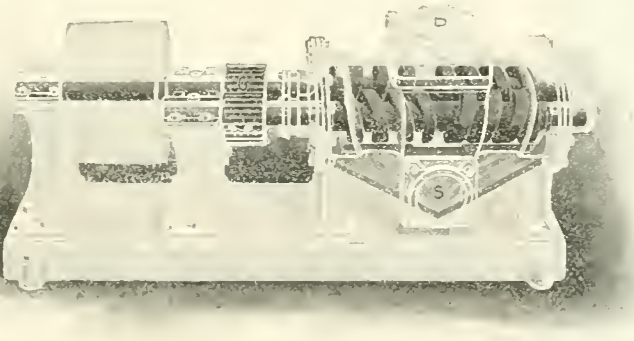

FIG. 1.

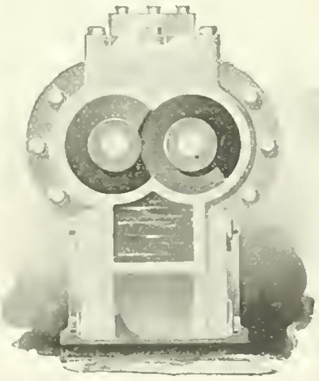

FIG. 2.

Without attempting to refer to the many more or less successful efforts of other inventors, contemporary with or prior to Mr. Quimby, this paper will be confined to a brief description of the pump, with some further reference to its commercial success. The latter is, of course, a first consideration to the manager or owner of electrical power, since any appliance which offers increased permanent demand for current must add a corresponding value to his franchise.

As will be noticed by an inspection of the accompanying illustrations, the Quimby pump consists of two parallel shafts, on which are mounted the four screws that act as pistons in propelling the water, so arranged that in each pair the thread of one screw projects to the bottom of the space between the threads of the opposite screws. The screw threads have flat faces and peculiarly undercut sides; the width of the face and the base of the thread being one-half the pitch. The pump cylinder fits the perimeters of the threads, as shown in figure 2. Space enough is left between the screws and the cylinder and between the faces of the intermeshing threads to allow a close running fit without actual contact. There is no end thrust of the screws in their bearings, because the back pressure of the column of liquid is delivered to the middle of the cylinder, and the endwise pressure upon the screws in one direction is exactly counterbalanced by a like pressure in the opposite direction.

The suction connection is shown at S in Fig. 1, and opens into a chamber underneath the pump cylinder. The suction liquid passes through this chamber to the two ends of the cylinder, and is forced from the two ends toward the centre by the action of the two pairs of intermeshing threads, the discharge being in the middle of the top of the cylinder, as shown at D. The power to drive the pump is applied to one of the shafts, and the second shaft is driven by means of a pair of gears, shown at G in Fig. 1.

The pump has no internal packing, no valves, and no small moving parts. The only packing is in the stuffing boxes where the two shafts pass through the cylinder head. As these stuffing boxes are on the suction end of the pump, there is no tendency to blow out the packing.

The Quimby electric pump is especially valuable in connection with the hydro-electric operation of elevators. These pumps have been in use for elevator service for several years with very satisfactory results, and have been successfully applied to the pressure tank system, the gravity system, and for pumping directly into the elevator cylinder.

When used in connection with the pressure tank system, the suction is connected with the elevator discharge tank, the pump discharging into the pressure tank. The pump is controlled by means of a pressure regulator and starting box, as illustrated in Fig. 3. When the pressure in the tank falls, the regulator operates the starting box and the pump runs until the pressure has been restored in the tank to the required number of pounds.

By the peculiar construction of the Quimby pumps there is no pulsation, and the flow of water is smooth and continuous, thus enabling the pumps to pump air into the pressure tank easily and without danger of air binding.

When used in connection with the gravity system, the pump section is connected with the lower discharge tank, and the discharge from the pump is elevated into the roof tank. The pump is controlled by means of a float in the discharge tank, and a starting box. When the discharge tank is full the float rises and starts the pump; the pump then runs until the discharge tank is empty and the roof tank is full. When the discharge tank has been emptied the float stops the pump. This system of control is simple and works exceedingly well in practice.

For pumping directly into the elevator cylinders, these pumps have a very high efficiency. The multiplication of cylinders in a reciprocating pump diminishes the intensity of the effect of the pulsations by increasing their frequency, but does not entirely remove the pulsations. Where Quimby pumps have been applied to pumping directly into the elevator cylinders, the motion of the cars is as smooth as in the pressure tank system. The advantage of direct pumping is that the pressure against which the pump works is proportional to the load in the car, and as the average elevator load is about half the maximum load, the saving in comparison with the pressure tank system is obvious. Where an elevator has been operated by water from the city mains, a considerable saving can usually be effected in the cost of operation and the service much improved by the application of an electric pump.

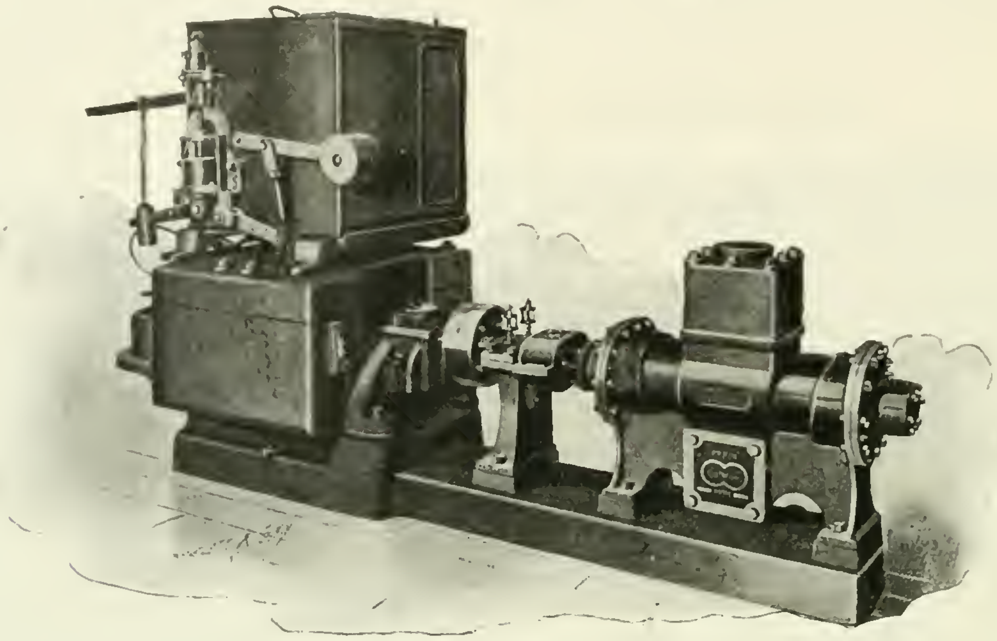

Fig. 3.

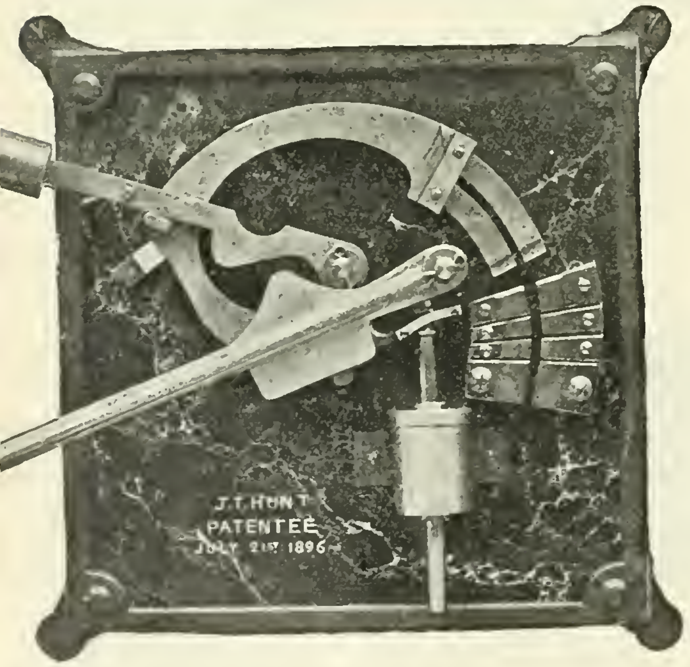

Fig. 5.

It will be seen from the foregoing description that the Quimby electric pump, when applied to an elevator, can be automatically operated, thus doing away with the constant care and attention required by a steam pump.

Figure 5 represents a switch for automatically starting and stopping electric motors up to and including five horse power. It is arranged to allow the current to gradually enter the motor through resistance, preventing undue sparking at the commutator at the time of starting the motor, thus taking the place of a starting box or rheostat, which is usually operated by hand. For pumps of larger size it is advisable to use the controlling apparatus shown in Fig. 3.

Whether operated by belt or direct connected to electric motors or steam engines, the Quimby pump has many advantages. For waterworks, oil refineries, or other service where liquids are pumped through long pipe lines, any pulsation in the delivery adds to the difficulty of maintaining tight joints. The Quimby pump, however, has an absolutely pulseless delivery, and at the same time a very high efficiency. Long series of tests show an average efficiency of more than 55 per cent. from wire to water. In many instances tests have shown as high as 65 or 66 per cent. efficiency. The log of two tests is given below in order to show the variation in output of current per gallon of water pumped under different heads.

TEST NO. 1

No. 2½ Quimby pump direct connected to 1 h.p. Lundell motor.

Pressure.	Volts.	Amperes.	Revolutions.	Lbs.	Time.
2	226	1.25	1860	292	1 min.
10	230	1.75	1650	244	"
20	230	2.00	1520	208	"
30	220	2.50	1280	178	"
40	226	3.00	1255	160	"
50	222	3.25	1130	133	"
60	228	3.75	1130	122	"
70	234	4.5	1020	102	"
80	224	4.5	990	81	"
90	222	5.0	955	76	"
100	234	5.5	950	75	"

TEST NO. 2.

No. 5 Quimby pump direct connected to No. 4 Otis motor.

Pressure.	Volts.	Amperes.	Revolutions.	Gallons.	Efficiency.
30	210	35	1280	316	56
40	"	43	1260	300	57
50	"	49	1220	286	60
60	"	57	1180	273	59½
70	"	62	1160	250	58½
80	"	68	1100	231	56
90	"	75	1080	222	55

The peculiar construction of the Quimby pump is such that it will readily handle thick products, such as paraffine, hot tar, pitch, white lead, melted sugar, glucose, soap, lard, etc. For this service, reciprocating pumps are not desirable, for the reason that heavy liquids are likely to be churned by the action of the plungers, and the friction of the material passing through the valves and ports, greatly reduces the capacity and efficiency.

The Quimby pump has now been in actual use sufficiently long to have passed the experimental stage. It is being used for all kinds of service, under most trying conditions, and the results have proved its efficiency, durability and economy.

The writer recently inspected one of the number seven pumps installed in the New York Sun building, where it is being used in connection with elevators operating on the pressure tank system. The arrangement of the pump and motor is the same as shown in Figure 4, while the rheostat and controlling device are similar to that shown in Figure 3. The instant the pressure on the gauge tank indicated a discharge of the water, the controlling device would close the circuit and start the pump, which would continue to run until the pressure reached the normal limit, when the current would be shut off, and the pump would stop. In its operation, both pump and motor appeared to be perfectly automatic, and the absence of noise and vibration was very noticeable.

The writer was also shown other installations of Quimby pumps for various purposes, such as tank service for high commercial buildings, elevating melted sugar from the basement to the top floors in refineries, and for other service.

Altogether the Quimby pump appears to offer a wider range for the utilization of electric power than any other apparatus presented for some time past and in a field also where cost of installation and operation are both very important factors.

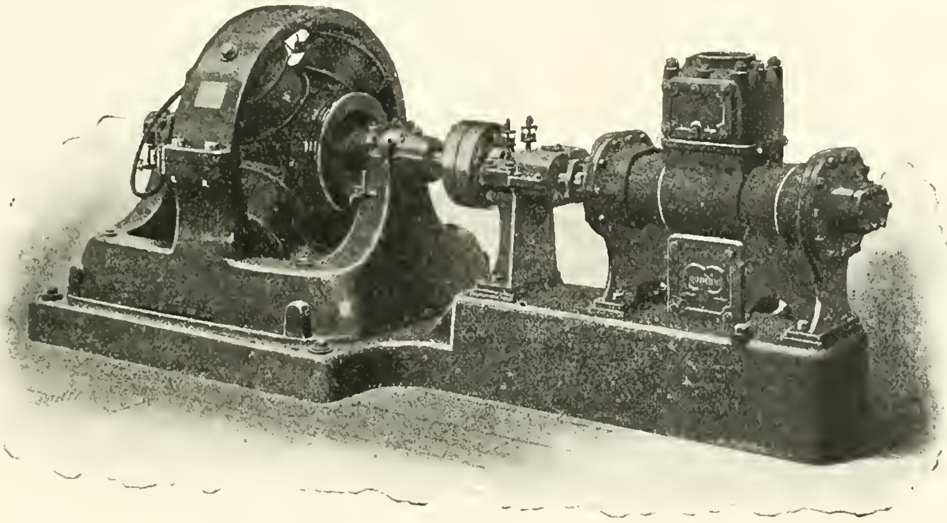

FIG. 4.

THE TELEGRAPH IN BRITISH COLUMBIA.

By R. B. McMicking.

SINCE that excellent paper on the "Early Construction of Telegraph Lines in the Dominion" was submitted at the fifth convention by Mr. Charles P. Dwight, I have had in mind the need of a supplementary clause concerning the introduction of the telegraph into this province in the early sixties, and which was to constitute a section of the somewhat formidable undertaking of connecting the New with the Old World by means of about eighteen thousand miles of land line.

It may be—it doubtless is—within the recollection of some of our members that, on the failure of the first Atlantic cable in 1858, there was set in motion as a means of attaining the same end—i.e., telegraphic communication between the two hemispheres—a gigantic enterprise, known as the "Collins Overland Telegraph (Russian Extension) Company," having in view the stretching of a wire from the telegraphic system of the Pacific States, through British Columbia, and via Behring Strait to Russia and Europe.

With marvellous energy and enterprise, the work of construction was commenced in 1863, the line entering British Columbia from the south in Longitude 122 W. in 1864, being carried thence to New Westminster, from which point it followed the valley of the Fraser river and the Cariboo wagon road northward to Quesnelle, a distance of about 450 miles, which point was reached in 1865. Offices were established along the way, and from Quesnelle southward the line was soon opened for commercial business. The enterprise proved a great boon to the early colonists, both by reason of the large expenditure necessary in its construction and operation, as well as by the facilities offered thereby to the widely separated settlements for speedy communication.

In 1865, also, a branch line was run across the San Juan Archipelago to Vancouver Island, connecting Victoria, the capital of British Columbia, with the main line at Swinomish, Washington Territory. This branch was about 74 miles in length, including five submarine cables of a combined length of about 16 miles.

From Quesnelle the main line crossed the Fraser river to the westward, and following a north-westerly course, with Behring Strait as its next objective point, reached the Naas river—about 400 miles distant from Quesnelle—when the second Atlantic cable was successfully laid, and operated July 29th, 1866.

The construction party of about 250 men—and which included explorers, surveyors, choppers, line builders, operators, and transport gangs—on receiving the news of the completion of the cable, remained in camp two or three days, awaiting developments. At the end of this time, finding the cable continued to work well, they set out for civilization, leaving their tools, stores and material to the tender mercies (in great part) of the Hudson's Bay trappers and the native red man, as their transport out would have cost more than the new article.

During the winter of 1866-7, a station was maintained at Fort Stager, on the Skeena river, where an operator by name of McCartney and a companion domiciled until the following spring, and where oftentimes during those—to him—dreary winter months I held converse with him by wire from Yale.

In addition to the construction party, the company owned and had in service a fleet of vessels, steam and sail, plying upon ocean and river, some in the transportation of material, supplies and line equipment, others in preparing for the placing of a cable across Behring Strait, a distance of about 60 miles—quite an undertaking at that date.

Of the fleet, I now recall the ocean steamer "George S. Wright," the river steamer "Mumford," barques "Onward," Clara Bell," "H. L. Rudgers," ship "Nightingale," schooner "Milton G. Badger." The "Onward" made a trip to Siberia with material and supplies, was caught in the ice—where she remained all winter—and became a wreck when the ice moved in the spring.

The Behring Strait cable was to stretch from Cape Prince of Wales, on this side, to Plover Bay, on the Siberian shore, from which latter point inland about 350 miles of line had been erected, while southward from Cape Prince of Wales, in Russian America, about 300 miles of land line had also been constructed.

The course of this contemplated line through the British possessions and down the great waterways of Russian America would doubtless have brought it into close proximity to the present Klondyke gold fields, and near Dawson City, in which event it is not improbable that the hole-digging necessary would have developed the riches of that section at least 30 years earlier, and have given to the former generation an additional important mining epoch.

The history of the building of this line, and the causes which led to a work having for its object the encircling of the world by wire at so early a date, is likely always to be read with interest.

The company—which subsequently merged into the Western Union Telegraph Company—maintained the line northward as far as Quesnelle until purchased in 1870 by the British Columbia government, which in turn handed it over to the Dominion government on British Columbia entering the Confederation in 1871. Later still, the Canadian Pacific Railway assumed control south from Ashcroft. While under government control, and previous to the influx of population consequent upon the building of the Canadian Pacific Railway, the revenue fell far short of the expenditure yearly.

In 1867, Buie Bros., merchants, built a branch line from Quesnelle to Barkerville, in the Cariboo gold region, a distance of 60 miles. This branch, together with the main line between Quesnelle and Ashcroft, is still operated by the Federal government.

The original expenditure in the construction of the British Columbia section of the Intercontinental line reached the large sum, roundly, of three million dollars.

I have written from memory, yet, doubtless, with comparative accuracy, through having been in the company's service during construction and for some years afterward, and while in charge of Quesnelle office in 1866 becoming the medium by which the news of the successful laying of the Atlantic cable, July 29th, 1866, reached the construction party 400 miles north-west of that point on July 30th, 1866.

THE STEAM END.

By James Milne.

In a paper read at a former convention of this Association, it was stated that purchasers of electrical apparatus made very careful enquiries as to the efficiency of same, the price being of secondary importance. If this applies to the electrical, why should it not apply to the steam end as well? I am sure that there are very few plants where the proprietors, or those in charge, inquire as to the efficiency of the boilers and engines, the price with these items being the very first consideration, generally.

It is very seldom, in specifications for steam plants, that there is anything said about the efficiency of the boilers, or the water consumption per horse power hour at the engine. This I consider one of the most important points in connection with the steam plant. There are engines running which are supposed to be first-class and up to date, where the water consumption per horse power hour is nearly double what it ought to be, and if the management in some of these plants would go to the trouble of calculating the coal consumption per electrical horse power at the bus, I am of the opinion that the results obtained would simply astonish them. I, myself, have records of the coal consumption of a plant, together with the total meter readings, extending over a number of years, and allowing for the loss on the line, together with that on the generators, and although the plant was a non-condensing one, yet the records there are not out of the way. In another plant where I was making a two days' test as to the relative values of coal, I found the coal consumption per E.H.P. at the bus just double the former plant, which might be considered high by some. This second plant was condensing. The load was of such a nature as to make the engine very unsuitable for the work.

I am inclined to think that builders of engines should be made to guarantee a certain steam consumption per indicated h.p. at say 25% over-load, full load and half load, and that tests should be made to determine if the guarantee has been fulfilled. If the guarantee has been more than fulfilled, let a bonus be given to the builders, and if not fulfilled, so much to be deducted for every 1% below the guarantee; and if it falls below a certain amount, that is to say, the steam consumption exceeds a certain fixed value, the engine to be removed, or the builders to accept a nominal figure for same. I think if means of this kind were adopted we would get engines of a very high order. Engineers, as a rule, are content so long as they get a fine looking card from their engine, but they very seldom from these cards calculate the steam consumption, which is of vital interest.

We have quite a large number of good engine builders in the country, but the number guaranteeing their efficiency is very limited indeed; in fact, I am not aware of any. If tenders are invited for a certain style of engine and the tenderers are called upon to guarantee the steam consumption per B.H.P., the party to receive the contract is the one guaranteeing the least steam consumption per h.p. hour, the cost being of secondary importance. After the engine has been installed and run for some time so as to get down to its proper bearing, carefully conducted tests should be made to ascertain if the guarantee has been fulfilled.

The matter of efficiency of boilers is also one of great importance, but it is not so easily arrived at, owing to the difference in coal. At the same time however, it would not be a very difficult matter to fix on a certain coal for a standard, and to guarantee so many pounds of water evaporated per lb. of that coal. All boilers, I believe, should be sold by the Centennial Standard, and should be capable of developing their rating with easy firing, showing good work with ordinary coal, and should be capable of being forced 50 per cent. above their rating. There was a recommendation something to this effect made by the Committee of Judges at the Centennial Exhibition, the horse power being 34½ lbs. from and at 212°, which is equivalent to 33,305 heat units. We should get an efficiency close on to 80% with good boilers, and this could be roughly determined with anthracite coal, and if we get 12 lbs. of water evaporated from and at 212°, we have approximately this efficiency, the heating value of the combustible being about 14,500 heat units, which is equivalent to 15 lbs. evaporated from and at 212°, therefore 80% of this gives us 12 lbs. With bituminous coals we have not such uniformity, and it is necessary to determine its heating value either by the coal calorimeter or chemical analysis.

After our boilers and engines are installed, we have to face the problem of running them. It has often been stated that men could be got to do anything, men being more easily replaced than machinery, costing practically nothing as it were. I am of the opinion that this is wrong. Cheap men are numerous we know, but are in the long run very expensive. Good men are scarce, and nowhere is this more noticeable than in the boiler room. Good firemen are very scarce, coal shovellers numerous. In my humble estimation, credit is not given to the fireman that should be. If a plant is run fairly economical as far as coal consumption is concerned, the engineer is more apt to get this credit, but as a matter of fact all he does is to turn on the steam and see that the bearings are oiled. Now and again he may walk into the boiler room to ascertain if the fireman is asleep or not.

To have good firing the greatest of skill has to be manifested to get the best results from the coal, and where we are dependent on skill to get first-class results we are depending on a very uncertain quantity. Too much latitude is given the fireman in the matter of coal, and he has it in his power to make or lose nearly a dividend for the company that employs him. Attention is being given to this subject by the largest steam users in the country, whereby the duties of the fireman are being greatly relieved by mechanical devices; their action being positive and not dependent on skill, the machines thus taking the place of the brains of the fireman. This you will agree is a great step in advance, and makes central station management very independent regarding firemen.

SPARKS.

The Kingston Locomotive & Engine Company have re-elected the old board of directors.

The Whitney Electric Company's works at Sherbrooke, Que., were damaged by fire last month to the extent of $1,000.

After using acetylene gas in the Methodist church at Leamington, Ont., it has been decided to return to electric light.

At the annual meeting of the St. Martins, N.B., Telephone Co., the former board of directors and officers were re-elected.

A. Schneider & Co., Pearl street, Toronto, manufacturers of electrical machinery, etc., have removed to 106 York street.

Mr. T. A. Crandall, of Picton, Ont., in remitting subscription to the Electrical News, writes: "I don't think I could get along without your paper."

It is stated that Gordon & Phillips, of Chatham, Ont., will establish a woollen factory at Tweed, Ont., and put in an electric light plant.

The steamer "Lakeside," plying between Toronto and St. Catharines, is shortly to be fitted with a complete new system of electric bells.

The village of Acton, Ont., will probably install a municipal lighting plant. An electrical engineer may be engaged to report on the matter.

The Deschenes Electric Company have submitted a proposition to the council of Ottawa East to supply light and power. The question will be considered at next meeting.

The electric street railway at St. Thomas, Ont., was put in operation last month. The railway cost about $80,000 and is six miles in length, and the entire equipment is very complete.

The George White & Sons Co., engine and machinery manufacturers, of London, Ont., have recently completed a new building, 175 × 35 feet, in which to manufacture threshing machines.

The village council of Iroquois, Ont., has under consideration a proposal from Mr. Keefe for an electric lighting franchise. Should an agreement be reached, Mr. Keefe will put in the necessary plant.

The employees of the Ottawa Electric Railway recently asked for shorter working days, but were informed by the company that this could only be granted upon a corresponding reduction in wages.

At the session of the Provincial Legislature of British Columbia recently adjourned, incorporation was granted to the Mountain Tramway & Electric Co. and the Nanaimo Electric Light, Power & Heating Co.

An exchange recommends the use of oak bark as a preventive of corrosion in steam boilers. Tests have been made which are said to have proven satisfactory, one or two oak slabs only being put into the boilers.

The Strathroy Electric Co., Limited, have met with so much success that they recently placed an order with the Canadian General Electric Co. for the installation of another 500 light single phase alternator.

The Ashcroft Water, Light and Power Company will erect a power house on the Bonaparte river, about three miles from Ashcroft, B.C., and install an electric plant to furnish light and power to Ashcroft, and for irrigating purposes.

J. R. Goodchild's electric light plant at Amherstburg, Ont., was put in operation last month. The generator is a 600 light Westinghouse of the latest design, the engine 75 h.p., and the boiler 150 h.p. Mr. McLean is electrican.

Mr. O. E. Young, of Magog, is building a small pleasure boat for Mr. L. B. Ward, of Brooklyn, N. Y., to be used on Lake Memphremagog, and an order has been placed with the Jenckes Machine Co., of Sherbrooke, Que., for one of their 7 h.p. Dake marine engines, with boiler to run the same.

The project to produce water power by the construction of a channel from the Welland to the Jordan rivers has again been revived. Mr. Wm. Pearson, C.E., of Oswego, is said to have pronounced the scheme feasible from an engineering standpoint, and the question of disposing of the power will now be tested. Mr. Pew is the promoter.

The Ottawa Electric Co. have supplied their employees whose duty it is to read meters with a portable electric light worked on the storage battery system. The light is five candle power and will run continuously for twelve hours without change of battery. The article complete weighs only 8 ounces, and the battery may be readily carried in the coat pocket.

The corporation of the town of Granby, P.Q., recently gave the contract for the installation of their lighting plant to the Canadian General Electric C. This plant will consist of a 100 k.w. monocyclic generator, complete equipment of station instruments, and a 50 light Wood arc dynamo. The contract also includes the complete installation of the pole line, transformers and house wiring required.

The New Brunswick Telephone Company recently elected the following directors: Hon. A. G. Blair, president; F. P. Thompson, managing director; J. L. Black, vice-president; W. E. Smith, secretary-treasurer; Dr. A. A. Stockton, Chas. Fawcett, C. F. Sise, W. T. Whitehead. The directors have decided to replace the present wire on the trunk system between Fredericton and St. John and Amherst, N.S., with copper wire.

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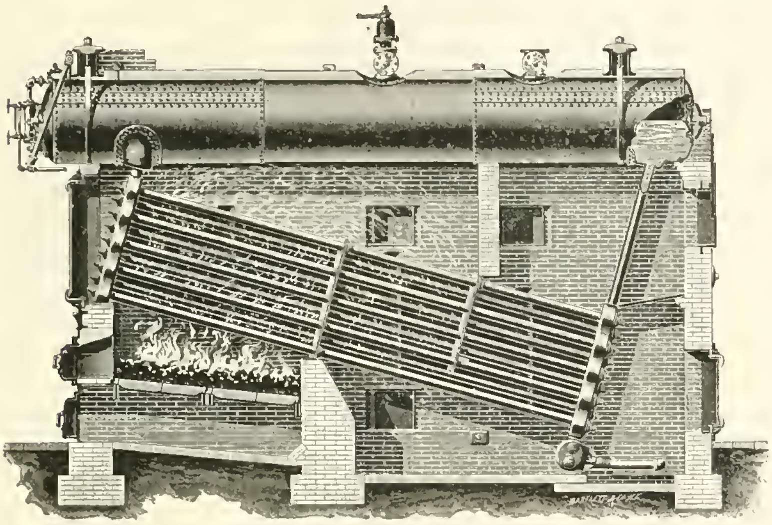

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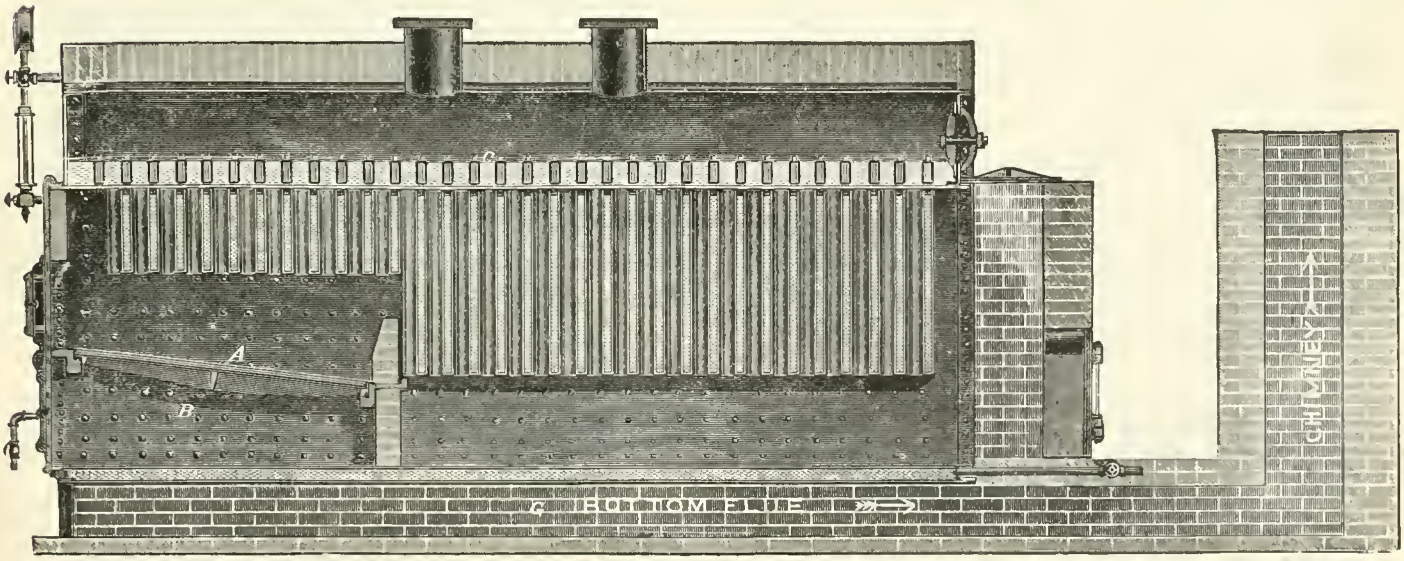

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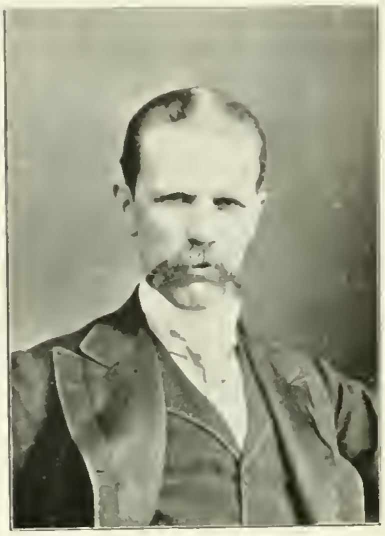
PROF. C. A. CARUS-WILSON.

It is with much pleasure that we publish herewith a portrait and some particulars of Prof. Carus-Wilson, who recently resigned the McDonald chair of Electrical Engineering at McGill University, Montreal.

Prof. Charles Ashley Carus-Wilson is the youngest son of the late Rev. C. Carus Wilson, Vicar of St. Mark's, Leamington, and grandson of the well known author and philanthropist, the Rev. W. Carus-Wilson, of Casterton Hall, Westmoreland. He was educated at Haileybury College and entered the Royal Indian Engineering College at Cooper's Hill, near Windsor, by a competitive examination. Two years later he gave up his position at the head of his year, and the certainty of a good appointment in the service of the Indian government, in order to devote himself to electrical engineering at home, and subsequently in Paris, Brussels, Antwerp, Vienna and Bucharest, where he lighted up the palace of the king of Roumania. He then went to Cambridge, took his B.A. degree in honours (Natural Science Tripos) in 1887, and the M.A. degree in 1891.


Prof. C. A. Carus-Wilson.

After taking charge for three years of one of the laboratories at the Royal Indian Engineering College, Prof. Carus-Wilson was elected in 1890 to the McDonald Professorship of Electrical Engineering at McGill University, Montreal. The electrical department of the University was not then in existence, and Professor Carus-Wilson carried through the work of organizing it and equipping the laboratories with great energy and success. The number of students taking this course is now very large, and a practical test of its results is afforded by the work of the graduates in applied science, many of whom already hold with credit important and responsible positions.

During the eight years in which Prof. Carus-Wilson has occupied this chair he has given much attention to original research, especially in connection with the direct current motor. The results of this are embodied in the volume of Electro-Dynamics which Messrs. Longmans Green & Co., (London and New York) are now bringing out.

Prof. Carus-Wilson left Montreal in April last, and has since been giving a course of Cantor lectures in London on Electric Traction at the request of the Society of Arts.

In the words of the resolution passed by the Faculty of Applied Science at McGill University last April: "Prof. Carus-Wilson has aimed at founding a school of engineering of the highest type, and has made it both his duty and pleasure to encourage in the students that love of investigation which is the only real foundation for any true scientific work. His success as a teacher is best attested by the continued growth of the school and by the prominent positions occupied by graduates in the electrical course, while to the Chair of Electrical Engineering his special researches have given a greatly increased reputation."

MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H. M.	H. M.	H. M.
1....	No Light.	No Light.	.....
2....	No Light.	No Light.	.....
3....	No Light.	No Light.	.....
4....	No Light.	No Light.	.....
5....	P.M. 7.30	P.M. 10.00	2.30
6....	" 7.30	" 10.20	2.50
7....	" 7.30	" 10.50	3.20
8....	" 7.30	" 11.20	3.50
9....	" 7.30	" 11.50	4.20
10....	" 7.30	A.M. 12.40	5.10
11....	" 7.30	" 1.30	6.00
12....	" 7.30	" 2.20	6.50
13....	" 7.30	" 3.20	7.50
14....	" 7.30	" 4.20	8.50
15....	" 7.30	" 4.20	8.50
16....	" 7.30	" 4.20	8.50
17....	" 7.30	" 4.20	8.50
18....	" 7.30	" 4.20	8.50
19....	" 7.30	" 4.20	8.50
20....	" 7.30	" 4.20	8.50
21....	" 7.30	" 4.20	8.50
22....	" 8.00	" 4.20	8.20
23....	" 8.40	" 4.20	7.40
24....	" 9.20	" 4.20	7.00
25....	" 10.20	" 4.20	6.00
26....	" 11.20	" 4.20	5.00
27....	" 11.30	" 4.20	4.50
28....	....	" 4.20	4.20
29....	A.M. 12.00	....	
30....	No Light.	No Light.	.....
31....	No Light.	No Light.	.....
		Total......	156.30

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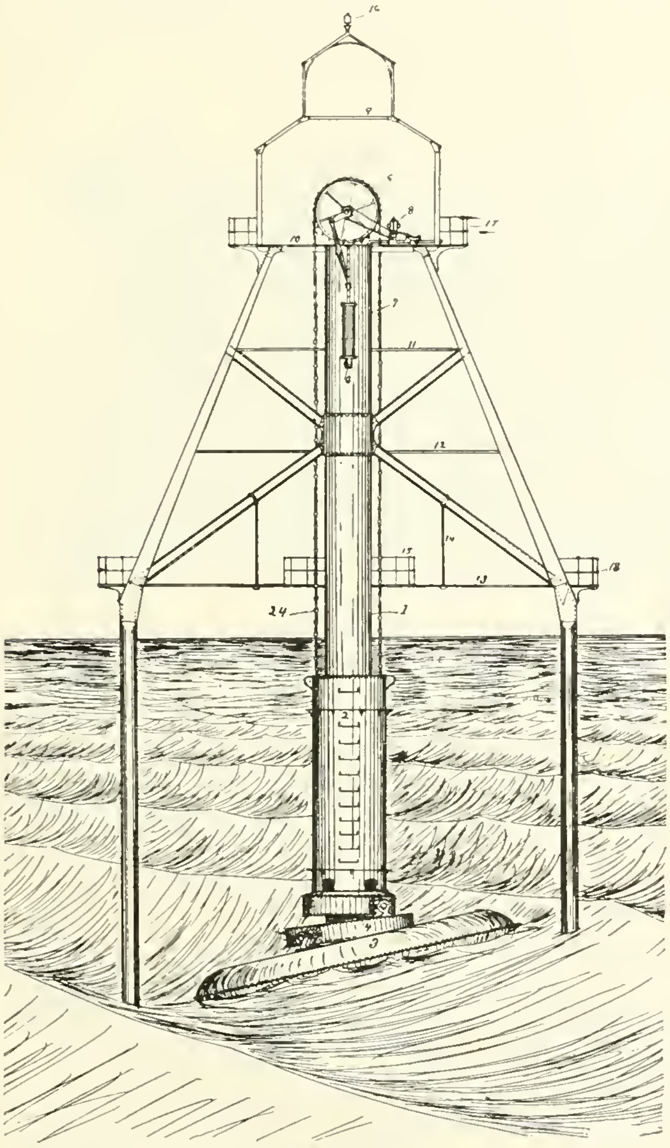
CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII. AUGUST, 1898 No. 8.

WAVE MOTOR.

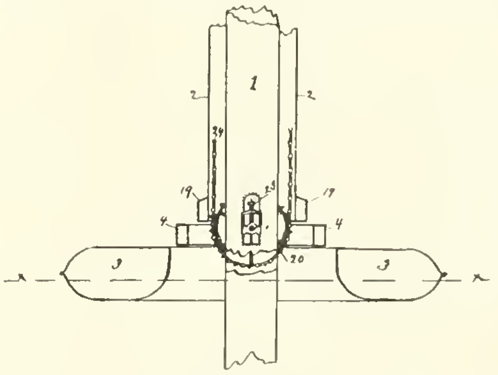
MR. Edward J. Ryan, of Milltown, Charlotte county, New Brunswick, has sent the ELECTRICAL NEWS drawings of a wave motor of which he is the inventor, and which he believes embodies many points of merit. The principle of the motor will be understood by reference to the accompanying illustrations, regarding which the inventor writes as follows :

Fig. 1 is a sectional view of the structure above water surface. 1, central stationary tube ; 2, truck tube ; 3, float; 4, hoop; 5, upper sprocket wheel; 6, compressed air pump (there is another pump directly on other side of air tank) ; 7, air tank ; 8, pressure govern device ; 9, light room floor ; 10, floor on which one or more dynamos may be placed ; 11, pump and engine room floor; 12, space on which dynamos can be placed, and to be used by the operators for their living apartments ; 13, lower floor ; 14, hanging rods to support centre of lower floor ; 15, rail circling opening in lower floor ; 16, fog whistle ; 17, upper promenade ; 18, lower promenade ; 24, endless sprocket chain.



WAVE MOTOR—FIG. 1.

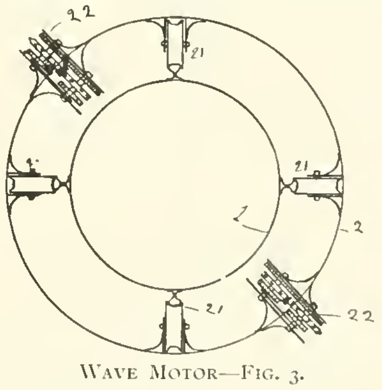
Fig. 2 is a sectional view showing lower sprocket wheel. It will be seen that the truck tube, 2, will play down by the lower sprocket wheel. 1 is stationary central tube ; 2, truck tube ; 3, section of float (x-x, water surface) ; 4, section of hoop ; 19, base section of truck tube ; 23, screw attached to lower sprocket wheel shaft bearings, to lift and lower the same ; 24, endless sprocket chain.



WAVE MOTOR—FIG. 2.

Fig. 3 is a top plan sectional view, showing the method of reducing friction of truck tube as it plays up and down on central stationary tube. 1 is central tube; 2, shell of truck tube ; 21, rollers and rail ; 22, chain gripping devices.

Fig. 4 is a chain grip device, to grip the chain on the upward motion. These devices consist of a sprocket and a roller, between which the chain passes. The sprocket tooth passes through the chain and enters a recess in the roller, so the chain cannot slip. The sprocket and roller shafts are provided with a cog wheel, which mesh together so that sprocket and roller will always turn together ; on the same shafts are placed a ratchet wheel, the same being provided with dogs. When these dogs are in position and the device is carried up, the chain must go with it, and when it descends the sprocket and roller will run down on the chain and

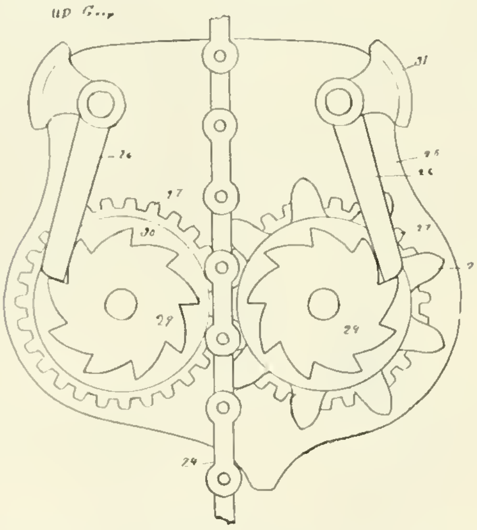


WAVE MOTOR—FIG. 3.

offer no resistance to it. When it is necessary to stop the chain, all that is required is to lift and throw back the ratchet dogs, and the device will offer no resistance to the chain either on the up or down motion. 24 is endless chain; 25, case plate; 26, ratchet dogs; 27, cog wheels; 28, sprocket wheel; 29, ratchet wheels; 30, roller; 31, weight on ratchet dogs.

Fig. 5 is view of down grip. This is just the same as the up grip, only the ratchet wheels and their dogs are placed in the opposite position. When the up grip has gripped and is carrying up the chain on one side, the chain is being drawn down on the other, and the down grip will offer no resistance to the chain. When the down grip has gripped and is carrying down the chain, the same is being drawn up on the other side, and the up grip will offer no resistance to the chain.

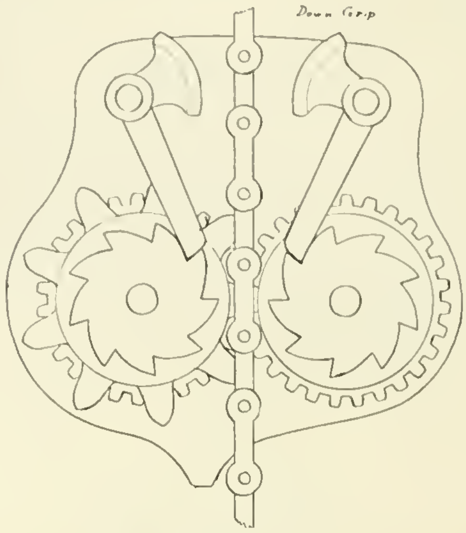
The machine is so different in construction from any yet produced that a number of experts have stated that they thought I had solved the problem of harnessing the ocean waves. I have produced the right sort of float, which is just as important a part of such a machine as the piston or steam valve is of the steam engine. The float being hung to truck tube in the way it is, assures a moderate up and down motion of the truck tube. If the float was fixed to truck tube stationary its motion would be different it would have rapid starts very often. This was proven by an experiment. Another great fault if it were fixed stationary and the float was flat is that a wave would rise over its end and the same would come and go so quickly that it would pass over the float before the latter would rise; on the other hand, if the float was of any depth it would not rise so quickly, and it would offer great resistance to the surface. All this I have mastered by hanging my float on a pivot; an elevation of water will pass through my structure and slide under the float and find very little resistance. It will do thisno matter from what direction the waves may come. I have provided my air tank with an automatic pressure governor, which insures a uniform pressure in tank in all sorts of weather. The air tank is also provided with a safety valve.



WAVE MOTOR—FIG. 4.

I see in the ELECTRICAL NEWS that Mr. Wm. Cross thinks that Thos. A. Edison, jr., got his idea to harness wave motion from him. Now, I think that Edison's machine is no more like Mr. Cross's invention than day is like night. I would say that Edison's machine is more like my own than any other, and permit me to say through your columns that if Edison has copied from any person's machine it has been from mine, as you can judge from the following:

On the 19th day of October, 1897, I wrote, and sent a sketch showing the outside of my structure, to Mr. Thomas A. Edison, offering to send the detail drawings and to give him a half interest in the patent if he would furnish the capital to secure the same. I gave him no information of my working gear, but informed him of the one great tube running down through the centre of the structure. He returned my sketch after a time, and told me that he was so busy that he had no opportunity to look into the subject. Now, in the New York Journal of January 14, 1898, there appeared the drawings and description of a wave motor, of which Mr. Thos. A. Edison, jr., was said to be the inventor, and it will be remembered that it stated that the development of the details of the plan was the work of a few months in the young wizard's mind. His motor consists of one great pump, the piston rod of which is connected direct to a float. It looks, without a doubt, that the Edisons thought that my central stationary tube was one great pump cylinder, and it also appears as though the young wizard found a little time to look into the subject.



WAVE MOTOR—FIG. 5.

CORROSIVE AND SCALE-FORMING AGENTS IN BOILER FEED WATERS.

By WM. THOMPSON.

[ARTICLE 7].

ANOTHER commonly met compound of a similar type is one containing large percentages of caustic alkalies, usually crude caustic soda. The reaction between sulphate of lime held in solution and caustic soda is similar to reactions already cited.

$$\underset{\text{Sulphate of Lime.}}{Ca\,SO_4} + \underset{\text{Caustic Soda.}}{2Na\,OH} = \underset{\text{Calcium Hydro-Oxide. (Lime)}}{Ca\,(OH)_2} + \underset{\text{Sulphate of Soda.}}{Na_2\,SO_4}$$

A similar reaction sets up between carbonate of lime and caustic soda. Water within the boiler soon becomes strongly alkaline and attacks brass and composite fittings very vigorously, also is very prone to foam; particularly is this the case if any saponifiable oil finds its way to the boilers. Compounds containing quantities of caustic soda in the absence of neutralizing agents can be with safety avoided.

Innumerable compounds have been introduced on the market containing organic acids, and some of these have good properties to recommend them. Chief among these are compounds containing "tannin" or tannic acid. Roger's process for the prevention of formation of scale consists essentially in the use of sodium tannate, which is a very useful reagent when properly made and applied. A reaction sets in between carbonate of lime and sodium tannate whereby insoluble amorphous tannate of lime is precipitated and sodium carbonate is formed, which in time acts upon any sulphate of lime present, reducing it to a carbonate of lime, thus leaving it in a position to be acted upon by a fresh supply of sodium tannate. Such reactions as these have sound chemical reasoning to recommend them. Care should be taken, however, that an excess of acid is not present in the solution, or damage to the boiler will occur. If sodium tannate is at all pure and made by trained chemists the reaction should always leave sufficient alkali present within the boiler to counteract the injurious effect of free tannic acid.

It will be seen from the foregoing that boiler feed waters are subject to a wide range of impurities and in widely apart quantities, so much so that the use of no single boiler compound can be relied on to attain satisfactory results. Each particular case must have individual attention. Where methods of this kind have been adopted and practical experience has been brought to bear on the subject, wonderful success has been attained. This is evidenced by the almost remarkable success that has been attained by such men as Geo. W. Lord, whose compounds to-day stand so high in the annals of steam engineering that genuine compounds bearing this name are now accepted without question.

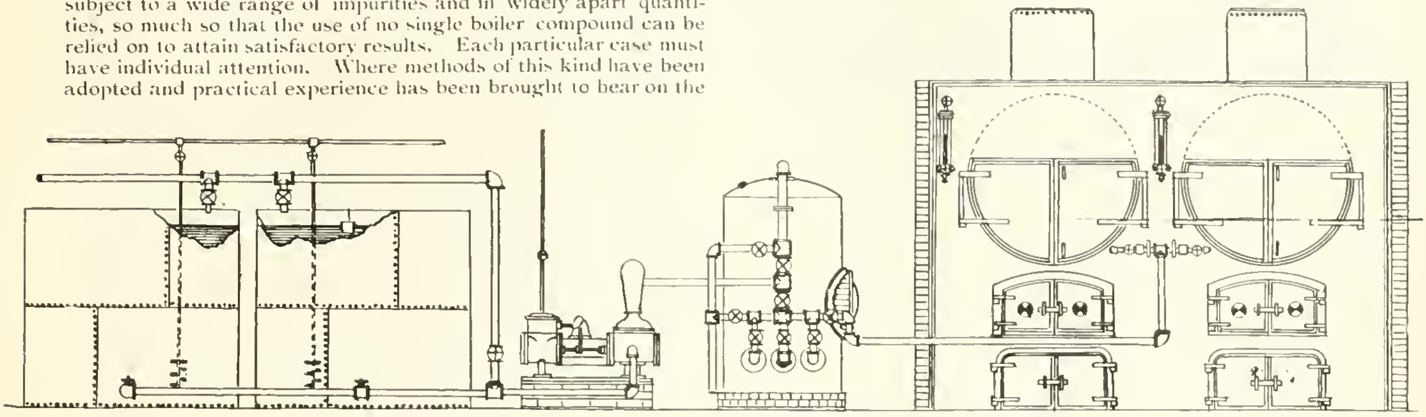


FIG. 1.

Treatment by chemicals aims to precipitate scale forming material as an insoluble, unhardenable sludge which can be easily separated from the water.

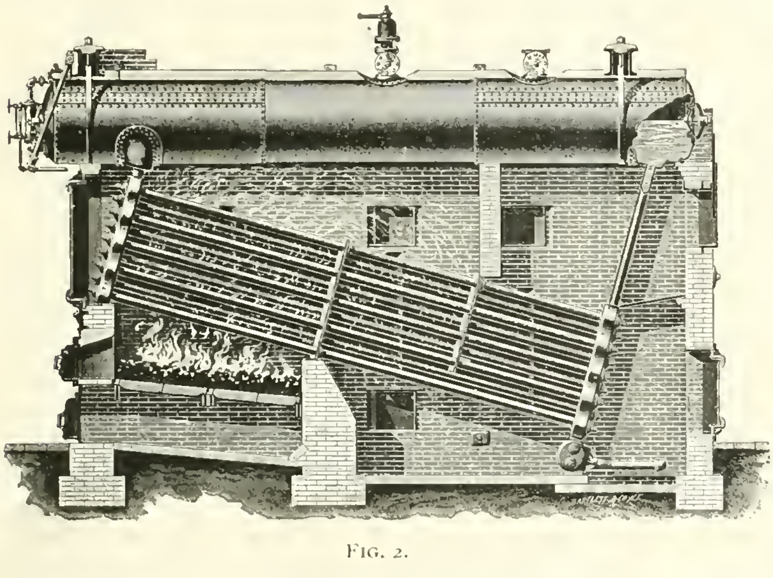


FIG. 2.

This method has very serious drawbacks, inasmuch as precipitation takes place within the boiler itself, and a thick pasty mass is liable to form directly over the fire box in certain styles of boilers of such a nature as to be quite as dangerous as the formation of the scale itself. We can then readily see that a successful method of dealing with scale forming waters demands both chemical and mechanical treatment—chemical treatment to precipitate scale forming agents, and mechanical treatment to extract this precipitate previous to delivering water to the boilers.

Every plant that makes any attempt at economy is provided with some means of heating feed water previous to delivering to boiler. The effect of this heater is to bring about a physical and chemical change on certain of the impurities contained by the water, and the presence of heat tends to aid precipitation and hasten the action of reagents; consequently all compounds should be fed into water gradually in sufficient quantity (previously determined) previous to water entering heater, when action will set in. Many of the manufacturers claim to extract the whole of the impurities at the heater by the simple addition of heat, while they are enabled, if a sufficiently high temperature can be reached, to cause precipitation of impurities. It is not quite as clear that this precipitate can be at once separated. Usually this precipitate passes over with the water to the boiler and is of an extremely fine nature whether chemical or physical means have been chosen to bring about precipitation. To prevent this a filtering arrangement, as shown in Fig. 1, is to be recommended.

This arrangement is intended to use two tanks of required capacity into which a definite quantity of reagent has been added and the whole is heated to about 212° Fah, water being fed from each tank alternately to boilers, sufficient time being allowed to lapse to complete chemical reaction before water is passed through filter intervening between tank and boiler. While these tanks are a distinct aid to the efficient working of the filter, they are by no means an absolute necessity. Water could be passed directly from heater to pumps, thence through filter to boiler. With care in choice of a reagent a method of this kind ensures clean boilers and successful treatment of waters otherwise unfit for boiler feed purposes.

Since, however, in bad waters filter is liable to be given a great deal of work, it is absolutely necessary that sure and quick methods for cleaning of filters are provided, and engineer requires to fully satisfy himself on this point before undertaking installation of a purifying plant on this principle.

In waters liable to throw down heavy precipitates in the absence of a filtering medium, or in small plants where capital investment becomes excessive for filtering apparatus, great care should be exercised in the choice of boilers. Construction should be such that all precipitates will deposit on lowest and coolest part of boiler at a point easily accessible and easily blown out. (See Fig. 2.)

This shows a type of boiler constructed with a view of securing precipitation of scale-forming impurities before water comes into actual contact with flues and plates of boiler exposed to high temperatures. Water containing the bi-carbonates of lime or magnesia or other salts that simply require heat to cause change of state from soluble to insoluble salts, being fed into the upper portion of boiler or portion used for steam drum, separation and precipitation would take place gravitating to lowest point or immediately behind baffle plate in front end of boiler, where blow-off is situated.

A type of boiler that has in the writer's experience given excellent satisfaction in this respect is illustrated in Fig. No. 3.

It will be noted that mud drum is provided at lowest point in this boiler, and placed in such a position that no actual contact with high temperature gases can occur; when waters have been treated as suggested, precipitate will follow current to lowest point and then settle. In this case mud drum acts as a receptacle for this precipitate, and being arranged in form indicated by cut, sludge or precipitate is concentrated in ready form for blowing out, and it has been the writer's privilege to have examined boilers of this type using waters that had been treated with chemical compounds and blow-off opened for a short time as occasion required to get rid of sludge, that were practically clean, although they had been in almost continuous use for nearly four months.

Both these boilers show distinctive types of mechanical arrangement designed to assist the water chemist in his work, and in closing these articles I wish to add my quota of thanks to the mechanical genius that enables this important question to be dealt with so successfully.

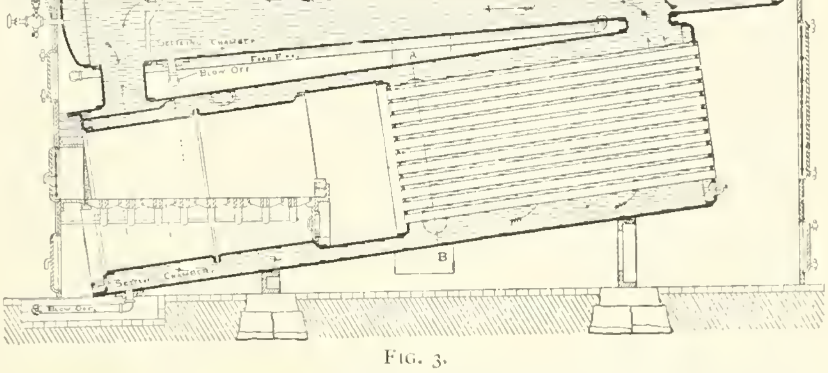


FIG. 3.

Mr. J. Walls, electrician, of Toronto, will have charge of the electric plant at Goldstream, B. C.

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Boiler Explosion at Sycamore.

THE recent boiler explosion in a saw-mill at Sycamore, Ont., by which the lives of four men were sacrificed, again emphasizes the necessity of compulsory inspection of boilers, and of having reliable engineers in charge of same. That public opinion is growing in this direction is shown by the recommendation of the coroner's jury that boiler inspectors be appointed and that engineers be compelled to hold certificates of competency. The jury, in their report, state that the explosion was caused by the pressure on the boiler being too great, which may be interpreted to mean that the accident might have been avoided by the exercise of more precaution and skill. In view of the number of explosions similar to that referred to above, the legislation which the Canadian Association of Stationary Engineers is seeking to obtain should, in the public interest, be heartily supported.

The Freight Transportation Problem.

REFERRING to the tramway paper presented by Mr. W. T. Bonner before the Canadian Electrical Association, the Electrical Engineer, of New York, says: "We are interested to note that at the recent meeting of the Canadian Electrical Association, serious attention was drawn to a plan for the standardization of farm wagons in such a way that they could be taken aboard bodily by trolley trucks and thus hauled to and from market. At first blush this looks like a rather wild project, but we confess we can see no good reason why some such plan should not be carried out in every rural region now tapped by a trolley service. The lessening of the cost for haulage and of loss from spoilage would be enormous; the trolley would open up a new country and a new source of income; the rates would be so low as to encourage the development of new lines of cultivation, and the ties between town and country would be more closely knit than ever. These things will come and must come soon, with electricity as the prime factor in their coming."

Electro-Metallurgy.

ANNOUNCEMENT of the fact that an electric plant of 20,000 h.p. capacity is to be immediately installed at Sault Ste. Marie, to operate the electric furnaces for the manufacture of nickel steel, for use in the Krupp gun and armor works at Essen, Germany, is a striking indication of the important part which electricity is to play in metallurgical operations and in mining development in the future. It is a fortunate circumstance that the practicability of the long distance transmission of electrical energy by water power for the operation of machinery and the extraction of valuable ores, should have been demonstrated simultaneously with the discovery of many valuable mining deposits in North Ontario and British Columbia. In the latter province a large amount of electric machinery has recently gone into use in mining operations, for rock crushing, hoists, tramways, etc., and is largely assisting to make possible the rapid development of the national resources.

Wiring Rules.

IN the discussion which took place at the recent convention of the Canadian Electrical Association, the fact was established that managers of electric companies are being subjected to much unnecessary annoyance and expense for lack of a uniform system of rules authorized by the Underwriters Association which should govern methods of electric wiring in all parts of Canada. It was likewise pointed out that in connection with such a uniform system there should exist one central authority to whom all questions in dispute between the companies and the inspectors might be referred, and whose interpretation of the regulations and decisions on disputed points should be accepted as final. At present the regulations differ as between one province and another, and even as between the inspection divisions of a single province, while each inspector interprets for himself the meaning of the particular set of rules under which he works. A wireman who has learned his business in Ontario, on removing to Quebec, finds himself confronted by regulations and methods differing so widely from those to which he has been accustomed that he is almost obliged to learn the business over again in case he is fortunate enough to be able to secure employment. The electrical companies claim that owing to unnecessary restrictions imposed by the underwriters the development of the industry has been retarded. To what extent this is the case we are not prepared to say. No one having the welfare of the industry at heart would wish to see relaxed any regulation necessary to the performance of work in a scientific, safe and substantial manner, but care should be taken to avoid imposts which, while not essential to this object, give rise to uncertainty, dispute, annoyance and expense. We have no doubt that as the result of the conferences which are to be held between the committee of the association appointed for the purpose and the underwriters, many at least of the causes of objection urged against the present wiring regulations will at an early date be removed. The Canadian Electrical Association is demonstrating its usefulness by dealing with this and other questions of like importance affecting the electrical interests, and is thereby commending itself to the sympathy and support of the electrical companies. Such questions may be expected to continually arise, and they can only be satisfactorily dealt with by an organization representing the interests involved.

Hazards of Acetylene Gas.

FIRE underwriters are still watching with no little concern the results following the use of acetylene gas as an illuminant, and from their observations and research are adopting rules to govern its use. Wherever the subject has been given attention, it has been found necessary to place stringent restrictions upon the employment of this gas. The National Board of Fire Underwriters of the United States have approved of a set of rules, based upon a special investigation of acetylene gas made by Prof. Henry Morton, of the Stevens Institute of Technology. These rules provide that the generating apparatus be situated in an outside fireproof building, that no artificial light be used in such building, and that the storage of liquid acetylene in any building, or the use of liquid acetylene gas, be absolutely prohibited. Mr. F. M. Griswold notes, in the Insurance Press, some of the physical characteristics of calcium carbide and acetylene gas as developed from investigations conducted by a number of European and American professors, and which are therefore of much significance. Commenting upon these characteristics, Mr. Griswold says: "The resume clearly demonstrates that grave fire explosive hazards are inherent to both calcium carbide and acetylene gas under conditions liable to supervene in every-day practice, as now permittted by some of the insurance organizations throughout the country, and it is high time that some concert of action be had by the insurance interests to secure the adoption of rules and regulations which, while granting the broadest latitude consistent with safety, will not unduly hamper the vendor, nor prove too onerous for profitable use of the apparatus by the purchasers." To convince some parties of the possibility of attaining high temperatures in the generation of acetylene gas from calcium carbide, Mr. William DeWitt, inspector for the Philadelphia Fire Underwriters' Association, made a test on June 18th last. Fifty pounds of carbide were bought in the open market, and one-half of same placed in a barrel open at one end. At 8 a.m. these twenty-five pounds were soaked with water and the gas allowed to escape; then the balance of the carbide (twenty-five pounds) was placed on top of the first and pressed down, the intention being to produce conditions which would pobably be met with should carbide on storage or under shipment become wet from the bottom, but the whole quantity not water soaked. Six hours later, at 2 p.m., smoke from burning wood was found to be issuing from between the staves of the barrel, and at 3 p.m. the barrel staves were in flames at the bottom. After smothering the fire, it was discovered that the bottom of the barrel had been entirely consumed.

S. C. Drummond, representing the British Electric Traction Co., of London, Eng., has applied to the town council of Nelson, B. C., for a charter for an electric street railway. The council has signified its willingness to grant the application on suitable terms.

A deputation of Toronto gentlemen approached the town council of Paris, Ont., recently on the subject of the construction of an electric railroad between that town and Ayr. It is understood that a charter has been applied for. A company is also seeking a charter under the name of the Grand River Electric Light and Power Co., to construct a stone dam across the river at Mr. Cavan's farm, with the object of supplying light and power. Mr. Fair, of Brantford, is the company's engineer.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE.—Secretaries of Associations are requested to forward matter for publication in this Department not later than the 6th of each month.

TORONTO NO. 1.

Toronto No. 1 have elected new officers as follows: President, Charles Moseley; vice-president, H. E. Terry (acclamation); recording secretary, J. W. Mair (re-elected); financial secretary, A. Stute; treasurer, S. Thompson (re-elected); conductor, W. Clarke; doorkeeper, J. C. Long; trustees, J. Fox, J. Huggett and W. Webb; delegates to the annual convention, J. Fox, C. Moseley, W. Webb, A. M. Wickens and T. Eversfield.

MONTREAL NO 1.

The first annual meeting of Montreal No. 1, since their removal to their new hall, 1863 Notre Dame street, was held on the evening of June 20th. The auditor's report for the fiscal year showed that the association was fairly prosperous financially, having a credit balance for the year. The election of officers for the coming year resulted as follows: President, Geo. Hunt; first vice-president, Wm. Ware; second vice-president, J. G. Robertson; treasurer, Thos. Ryan; secretary, Hy. Nuttall; conductor, W. Wadey; doorkeeper, J. Huntingdon; librarian, F. Thompson; corresponding secretary, P. McNaughton.

LONDON NO. 5.

At the last meeting of London No. 5 the election of officers took place. The result was as follows: Duncan McKinley, president; William Blythe, vice-president; G. B. Risler, treasurer; W. Allen, corresponding secretary; W. Meaden, minute secretary; James Harding, conductor; Henry Geldart, guard. The installation of officers was carried out in a very efficient manner by the past president, J. D. Campbell. Some questions were asked and discussed. The heating surface of a tubular boiler, 60 in. in diameter by 12 ft. long, with 84 3-inch tubes, was figured out on the blackboard by the past presidents, which was followed by a general debate on the water consumption per indicated horse power.

MOONLIGHT SCHEDULE FOR SEPTEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	No Light.	No Light.	.....
3....	P.M. 7.00	P.M. 9.20	2.20
4....	" 7.00	" 9.20	2.20
5....	" 7.00	" 9.50	2.50
6....	" 7.00	" 10.40	3.40
7....	" 7.00	" 11.30	4.30
8....	" 7.00	A.M. 1.00	6.00
9....	" 6.40	" 1.10	6.30
10....	" 6.40	" 2.10	7.30
11....	" 6.40	" 3.10	8.30
12....	" 6.40	" 4.20	9.40
13....	" 6.40	" 4.30	9.50
14....	" 6.40	" 4.40	10.00
15....	" 6.30	" 4.40	10.10
16....	" 6.30	" 4.40	10.10
17 ...	" 6.30	" 4.40	10.10
18....	" 6.30	" 4.50	10.20
19....	" 6.30	" 4.50	10.20
20....	" 7.20	" 4.50	9.30
21....	" 8.20	" 4.50	8.30
22....	" 9.20	" 4.50	7.30
23....	" 10.30	" 4.50	6.20
24....	" 11.00	" 4.50	5.50
25....	" 11.40	" 4.50	5.10
26....	....	....	3.50
27....	A.M. 1.00	" 4.50	
28....	No Light.	No Light.	.....
29....	No Light.	No Light.	.....
30....	No Light.	No Light.	.....
		Total......	171.30

LEGAL.

BELL TELEPHONE COMPANY VS. CITY OF HAMILTON.—The Bell Telephone Company appealed from the decision of a board of three county judges affirming the decision of the Court of Revision for the city of Hamilton, whereby the assessment of the appellants for 1898 was confirmed. The part of the assessment in question upon this appeal was that upon the poles, wires and conduits of the appellants, at $13,490. The appellants complained of the assessment of these articles as real estate, and also contended that it was excessive, the value for assessment being determined by taking the gross cost and deducting 15 per cent. for wear and tear. The Court of Appeal held that the equipment could only be taxed for their abstract value as raw material.

TRENTON ELECTRIC COMPANY VS. TOWN OF TRENTON.—This suit was brought for damages for breach of an agreement between plaintiffs and defendants, for specific performance of the agreement, and for a declaration of rights. The agreement contained no assent in express words to the plaintiffs placing their poles in the streets or stretching their wires across them; but the trial judge held, having regard to the method ordinarily adopted for transmitting the electric current, that it must be taken that defendants impliedly granted to plaintiffs such rights for these purposes as might be reasonably necessary to enable plaintiffs to carry out their engagements and to enjoy the rights conferred upon them, but there was nothing in the agreement to indicate that the purposes which the contracting party had in view were other than local and confined to the limits of the town, and the defendents could not be taken to have assented to the contract which would enable plaintiffs to use the power, which defendants had acquired at great expense, in order to build up their own town, for the purpose of promoting the interests of a rival municipality, and therefore plaintiffs were not entitled to transmit their power to Belleville. The Court of Appeal agreed with the Chief Justice's view and dismissed the appeal with costs.

HULL ELECTRIC CO. VS. OTTAWA ELECTRIC COMPANY.—The Hull Electric Company instituted an action in the Superior Court to compel the Ottawa Electric Company to remove its electrical apparatus from the city of Hull, and to cease supplying electricity to Hull and the people therein, and claiming $20,000 damages. The Ottawa Electric Company contended that it also had obtained from the city of Hull the privilege of supplying electricity there; that this privilege was granted to the Ottawa company previous to the grant to the Hull company; that the Hull company did not and could not have an exclusive privilege; that if the legislature of Quebec granted such exclusive privilege it was ultra vires of the said legislature. Mr. Justice Lavergne maintained the defendants' contentions. He held that the exclusive privilege claimed by the Hull Electric Company is ultra vires, null and void; that the local legislature exceeded its powers in attempting to give to the Hull company the exclusive privilege claimed by the latter; that electricity is a commercial commodity, the sale and supply of which cannot be given exclusively to any person or corporation; that the federal government alone has the power of granting such privilege or franchise. The action was consequently dismissed with costs.

PATENT RIGHTS.

THE General Engineering Company of Ontario, Limited, manufacturers of the Jones' underfeed stoker, have taken action in the Exchequer Court against the Dominion Cotton Mills Co., of Montreal, for having in use in their establishment a device which is claimed to be an infringement of the plaintiffs' patent rights.

Plaintiffs claim as follows: 1. That the defendants, their agents, servants and workmen may be restrained by injunction during the continuance of each of the said letters patent, from making, constructing, using or vending to others to be used in the Dominion of Canada, any boilers, furnaces or mechanical stokers, made according to or in the manner described in the specification of such respective letters patent or according to or in manner only colourably different from the same, and generally from infringing the rights of the plaintiffs in respect of such letters patent. 2. That the defendants and each of them may be ordered to deliver up to the plaintiffs all such boilers, furnaces and mechanical stokers as aforesaid, as are in possession or power of the defendants. 3. That the defendants may be ordered to pay damages to the plaintiffs for the infringement of their said patent rights. 4. That the defendants may be ordered to pay the costs of this action. 5. That the plaintiffs may have such further or other relief as the nature of the case may require.

Mr. Terence Cunerty has been appointed engineer at Osgoode Hall, Toronto.

A company is being formed at Brantford, Ont., to construct an electric road between Waterford and Port Dover.

The village of Campbellford, Ont., has voted in favor of raising $8,000, for the purchase of an incandescent lighting plant, to replace the one now in use.

DAY LOAD FOR CENTRAL STATIONS.

By "Economy."

How to obtain the greatest possible return for a given capital expenditure is a problem that interests investors in all lines of business, and not exclusively electric stations. It is one, however, that possesses a special interest for electrical investors, because, if their business be confined solely to lighting, then their whole investment is earning money during only a portion of each twenty-four hours, is not running for any considerable time at anything like full efficiency, and has yet to pay interest, depreciation and all other fixed charges, all day and every day. If the prices obtainable for electric light were not so very much affected by competition from gas, the matter of obtaining some extension of business for the plant would not assume such great importance; as it is, however, every means of increasing income without proportionately increasing expenditure should be thoroughly investigated. An electrical power house has four possible sources of income—light, power, heat and current for electrolytic purposes—and whether these are possible practically or only theoretically depends solely on local conditions. Before considering the several possible features of a day load, it may be as well to consider why such a load is deemed to be advantageous—what is the benefit (pecuniary, of course) to be derived from it?

In every central station there are certain fixed expenses, such as depreciation, taxes, insurance, interest on bonds, etc., that have to be provided for by the operation of the plant; and in a purely lighting plant, operating only about twelve hours on the average per day, the proportion of such fixed expenses borne by each 24 hours has to be provided by each 12 hours' run; or, one hour's run has to earn two hours' fixed expenses. If, now, work could be obtained for the plant during 16 hours, then the strain would be reduced, for one hour's operation would only have to earn 1½ hours' expenses, and so on. Another way of looking at the same question is that, assuming a certain more or less definite aggregate station output for each 24 hours' run, this aggregate amount can be generated in 18 hours' running by a smaller amount of machinery (and therefore at a lower charge for fixed expenses) than would be required for generating it in a 12 hours' run. Or, putting the matter broadly, the "time-efficiency" of a plant is greater the longer it runs per day.

The matter is, however, greatly complicated for the larger number of the central stations in the Dominion, by several very practical considerations; and it becomes a point for very careful investigation as to whether in any particular case a day-load is an advantage or very much the reverse. In the present state of the electrical manufacturing industry, it is open to doubt as to whether there is a really satisfactory and efficient single phase alternating current motor; and as the conditions in which direct current for distribution is equally as good an investment as alternating current are somewhat rare in our smaller towns, the day load of motors to be worked up must be sufficiently great to counterbalance the pecuniary loss sustained by distributing with direct current at a higher first cost. And, moreover, where a plant supplies both a power and a lighting load, it is evident that during the winter months the lighting, commencing at about 4 p.m., will overlap the power, which does not stop till 6 p.m. In this case either the two forms of load must come off the same mains, feeders, generators and engines, in order that the size of plant may be kept down, or else the two plants must be kept separate and distinct down to the boilers, at an increased cost for apparatus. In the former case any momentary fluctuation of the power load, acting through the distributing and generating system, will inevitably have an effect on the quality and steadiness of the lighting, which will vary according as the lighting or the power load is greater. In the latter, the duplication of all the necessary apparatus leaves the power question to be solved on the same basis as the lighting question, i.e., "Is there enough business to be done to make it a paying investment?" It may be taken for granted that no extensive, or even moderately large power business can be satisfactorily done by single phase motors. These can at best be regarded merely as an expedient—bad at the best—so the matter remains between d. c. distribution and polyphase, and comes down ultimately to the above result.

In summer time, no doubt, the power load will come off before the lighting commences, so that the same machinery will perform double duty, the only extra expense being for day wages and for fuel. But just as soon as the afternoons get short, and lighting starts up earlier and earlier, then the services will overlap, and there will have to be enough generating machinery for both combined. Looking at it in this way, there doesn't seem to be much advantage in working up a small day load, which will require extra machinery and day wages, and in probably the majority of cases it would not pay at all. But the operating industry has now arrived at a stage where it becomes advisable to investigate all these questions, and accept the results arrived at, even if they involve remodelling entire systems at considerable expense.

In most towns there will be found a waterworks system using direct pressure by means of pumps with or without storage tank. This will often afford a nucleus of a day load which may be profitably added to. Insurance requirements generally are that a certain hydraulic pressure shall be kept over the whole piping system night and day, which, of course, requires two shifts of engineering staff. An electric company having already a night shift provided, would only require a day shift to do this service, and could probably make arrangements with the town authorities for running the waterworks, which would save the town so much in wages alone as to make it good business for them to contract with the company, and yet have a good margin of profit for the company.

Arrangements could probably be made so that the electric plant could be placed in a building adjacent to the pump-house, and the two services combined under the one staff. The pumps could either be operated by steam as usual, or else (and preferably) electric pumps could be used. In this latter case it is probable that a considerable fuel economy could be effected, as the combined efficiency of an expansion engine, a high class generator and motor, would exceed that of a steam pump, which is not recognized as a very efficient steam-using apparatus. Thus the town would save the expense of an entire engineering staff and fuel, while the company would have a paying nucleus for a day load. Even though the two plants could not be combined in the same building, the pumps could be operated electrically, and a sufficient price obtained for the service to pay all expenses and leave a little over. Waterworks that use a standpipe generally arrange to do a certain number of hours' pumping during the 24 hours, leaving the pipe to supply the demand during the rest of the time. This presents a particularly favorable case for the electric company, for then it is always possible to do the pumping during daylight hours, between 9 a.m. and 4 p.m., except in the "lawn" season, when it will begin at say 6 a.m. and go on to 6 p.m. But then at this season lights are not required till later in the evening. So that this case allows of the station plant being run during a longer time every day, doing pumping and lighting with the same boiler and engines, and perhaps even the same generators, if they are either d.c. or polyphase alternating.

The mere pumping business may or may not be worth while undertaking, depending on the price, but if there is any other power business to be done in the town at all, it at least provides the machinery and engineer, and the rest can be undertaken on a thoroughly satisfactory basis. Even in this favorable case, however, it will be inadvisable to run motors off the regular lighting circuits, for two if not more reasons. First, unless the lighting be done solely on the meter basis, there will always be a certain number of persons who will allow their lamps to burn all day, simply because they "don't pay anything extra for it," which means unnecessary fuel consumption; and second, because in winter time, the loads overlapping, any fluctuation in the motor load from moment to moment will have an effect on the lights, causing them to flicker. If the proportion of the total motor load to the lighting load be large, and there be any units of considerable size in the former, then the throwing on or off of these large units may considerably affect the lights, but if the proportion be small and contain no large units, then such effect will probably be small, if not negligible. It therefore depends entirely on the proportion between the two classes of load as to whether they may reasonably be run off the same mains and feeders, or whether it will be more advisable to supply them separately.

Another form of day load which can only be availed of in d. c. plants is the storage battery. The main advantage attained in this case is not so much the working up of a day motor load to increase earnings, as the working during a longer period, of a smaller amount of machinery at lower first cost, and higher working economy. It is a matter of common knowledge that the maximum demand on a lighting plant—the "peak"—is very greatly in excess of the average load, and only for a very short time, and that similarly the minimum demand is considerably lower than the average, but lasts for some time. The plant has to have the capacity of the highest demand, and will therefore be operating at full economy for only a very short time during each 24 hours; and as the lowest demand is probably not much over one-quarter of the greatest, and continues for several hours in the early morning, the result is not only that a large amount of capital is lying idle for probably 20 hours out of each 24, but that such capital as is being rendered productive is employed at a very low economy. Storage batteries, while being available for supplying motor load, serve another purpose altogether, and a very useful one. The "peak" of the load may be taken by a battery, which can be charged by the generating plant during the long hours of light load. So the generating plant may be designed considerably smaller than the maximum demand, and can be run for a longer time at nearly full efficiency continuously.

In a d.c. plant, where the waterworks are operated in connection with the electric station as above, careful design in many cases may allow of such a proportion of generating and battery plant as that the former may require to run 20 hours each day at not less than three-quarter load. It will be evident that a very great economy will result, both in first cost and in operation, from such a design.

There is some little future before another method of supplying a day load with no increase of plant, but industrial conditions will have to be considerably modified before it becomes very general. If motor load and lighting load were consecutive always, and never concurrent, as they are during winter months, then it is evident that no overlapping would occur, and one set of generating machinery would be sufficient for both, and could run almost continuously; but while such overlapping is possible, it is necessary to provide generating plant for the sum of the two loads, although this sum occurs only for a couple of hours each day, during three or four winter months. If, during winter, the motor load could be supplied only during daylight hours from say 9 a.m. to 4 p.m. then the two loads would not interfere, and no increase of capital would be necessary. In many medium-sized plants, specially favorable terms are offered to manufacturers who will agree to do all their power work between these hours, and other business is refused. In such a case it would probably pay to run a special feeder and main circuit for power supply only, using the same electrical and steam plant to furnish current for power during day as runs the lights afterwards.

It is certainly not every case that presents a favorable field for day load, but the chances are that it would be possible and remunerative more often than is generally considered, and the above suggestions may be of use to some as indicating the direction in which to canvas.

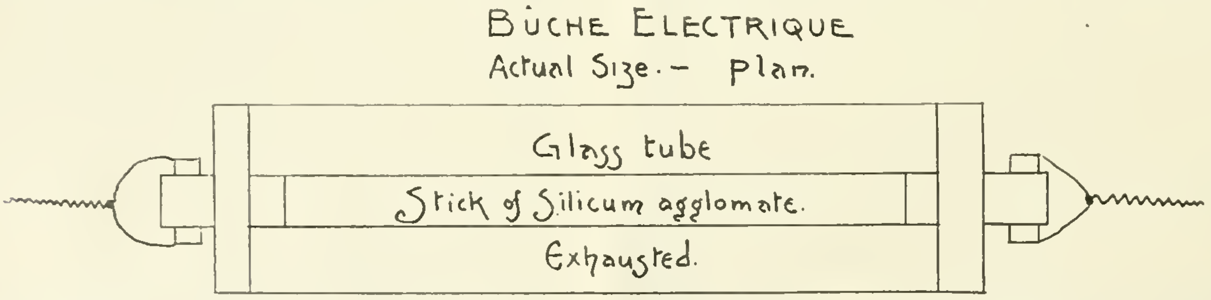
ELECTRIC HEATING AND ITS APPLICATIONS.[*]

By M. Fernand Le Roy, C.E.

In pursuing his researches Mon. Le Roy sought to attain the following results:

The construction of apparatus of such simple and handy form that the ordinary domestic would experience no difficulty in using it; to make the application readily available in conjunction with the present forms of saucepans, kettles, stoves, irons, etc., so that any change of method on the part of housekeepers would be avoided.

The system is described as consisting essentially in what is called la Buche electrique, or the electric log. A stick of silicum agglomerate metallised at each extremity in order to prevent the overheating of the joints and to insure good contact at the sockets is inserted in a glass tube, from which, to prevent the oxidation of the silicum, the air is exhausted. The two extremities of the glass tube are set in plaster and the metal ends of the stick are attached to the contact pieces in the same manner as in the case of incandescent lamps (see diagram).



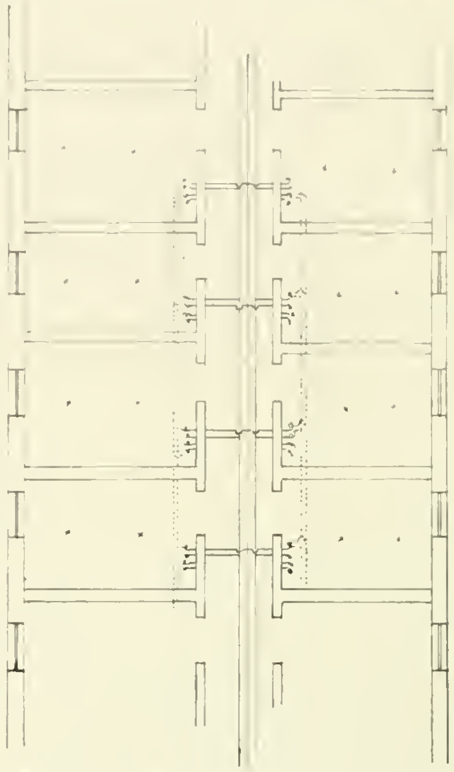
Metal spring clips render the insertion of the heater in the circuit an extremely simple operation.

Each buche or heater is constructed of such dimensions and resistance that the power absorbed under a pressure of 50 volts is from 60 to 100 watts, but of course they can be used under any voltage by arranging them in multiple series.

For warming rooms the apparatus would be particularly serviceable, and for general purposes in the kitchen this simple appliance is equally adaptable, as it can be utilized in connection with our present utensils. Hitherto electric cooking devices have been constructed on a much more elaborate and consequently expensive principle, but the method here described bids fair to revolutionize this branch of electrical industry.

WIRING OFFICE BUILDINGS.

Much difficulty is encountered in wiring office buildings on account of the necessity of having to alter offices, and the consequent changes to the wiring for electric light meters. The accompanying sketch illustrates to a certain extent a method adopted by Mr. H. F. Strickland, and which has been put into practical use. By it a building can be so wired that a suite of offices can be interchanged from one meter to separate meters, or vice versa. The sketch shows a section of an office building with a three-wire service in the corridor, with taps for each office. The four wires extending out of wall are two from service and two from outlets. The dotted lines might be termed a loop circuit, and by this circuit the current can be either connected direct to each office through a separate meter or carried through one meter to all the offices, and the meter can be placed in either office. An additional cost of running two wires through the offices, with a tap coming out beside each meter outlet, will save considerable expense in the future. Mr. Strickland, the electrical contractor, 77 Adelaide street east, Toronto, who is the originator of this method, will be pleased to explain the idea to architects and others who may desire to obtain further information.



Method of Wiring an Office Building.

A very good rule for the power that a belt will transmit is as follows: Multiply the number of square inches in contact with the smallest pulley by the speed in feet per minute and divide by 36,000. The result will be the horse power that may be transmitted, by a double belt, under the most favorable conditions. Deductions must be made according to the judgment of the engineer, for with a single belt under poor conditions but one-half of the above will be realized in practice.

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[*] Summary of paper communicated to the Society of Civil Engineers, Paris, Feb. 4, 1898.

ELECTRICAL POWER TRANSMISSIONS.*

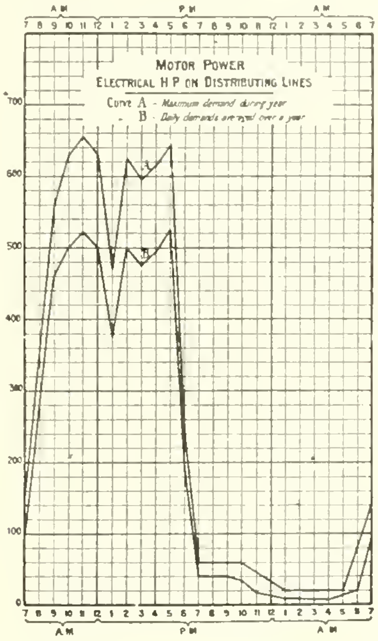
By R. A. Ross, E.E., M.Can.Soc.C.E.

(Continued from June issue.)

The table below illustrates the ratio of plant installed to the output column, one giving the average output per hour figured from the curves for a year, and column two the plant installed to meet maximum demands, while the third shows the ratio between them.

	Incandescent.	Arc.	Motor Power	Street Ry.	Total.
Average E.H.P. per hour.....	604	650	218	2,430	3,902
Max. E.H.P. required	2,925	1,300	656	6,450	11,331
Ratio output to capacity	20.6%	50%	33.3	37.7	34.4

It will be seen that the output is only about one-third of that possible with the plant which must be installed. To dispose of the remaining two-thirds is the ambition of every station manager.



It is just here that the storage battery finds its best field in steam station, but in water power plants it has no place unless the plant be loaded to its full capacity, and an increase is desired which the water available will not admit of.

As an illustration of what is to be expected, the above case is useful, but so simple a case seldom occurs in practice, as instead of having the curves of actual demand, the engineer usually has to draw upon his educated imagination for these, guided by his experience with similar plants.

Having determined the amount of power required for the various demands, and fixed upon the best method of distribution to meet those demands, the problem of the transmission may be taken up intelligently point by point.

GENERAL SYSTEM.

Considering the direct current as out of the question for large transmission purposes, three different alternating systems present themselves, namely, single, two and three phase. The first we are thoroughly familiar with, owing to its use in the purely lighting stations, where it is entirely satisfactory, but when it is necessary to distribute power for motor purposes, it fails, owing to the fact chiefly that single phase motors, while practicable, are not found suitable in operation, as they are not readily started from rest.

The question therefore hinges upon the point of relative superiority of the two and three phase systems.

So far as apparatus is concerned, these two systems are about on a par for all practical purposes when designed for the same conditions of operation, but for the line the three phase has the best of the argument, the transmission copper being reduced 25 p.c. This point of superiority, however, loses much of its effect, for it is possible to use two phase apparatus at both ends of the line, and by means of suitable transformers change from two to three phase for the transmission, in which case the capacity of the transformers used must be slightly increased, as some of the copper is partially inactive when coupled up for change of phase. For this reason the three phase will be adopted in the case under consideration, as being probably the cheaper in first cost and equal in efficiency.

VOLTAGE OF TRANSMISSION.

As the copper in the circuit varies inversely as the square of the voltage for the same loss and distance, the advantage of high voltage becomes apparent. Conversely with the same distance and copper, the loss in line may be reduced in proportion to the square of the proportionate increase, or the distance may be increased directly as the increase, and any combination of these may be attained by simply raising the voltage.

On the other hand, the apparatus installed must be designed to resist the effects of the increase on the insulation, and greater precautions are necessary to maintain it in operative condition. The cost will also be somewhat greater where especially high voltages are used.

The highest voltage in practical operation at the present time, so far as I am aware, is at Ogden, Utah, where 16,000 is used with raising transformers.

The highest generated directly on a machine without the aid of transformers is 12,000, at the Chambly plant. There are several now building, however, which contemplate a line voltage of 20,000, and we may expect to see this figure increased from time to time as methods of insulation improve.

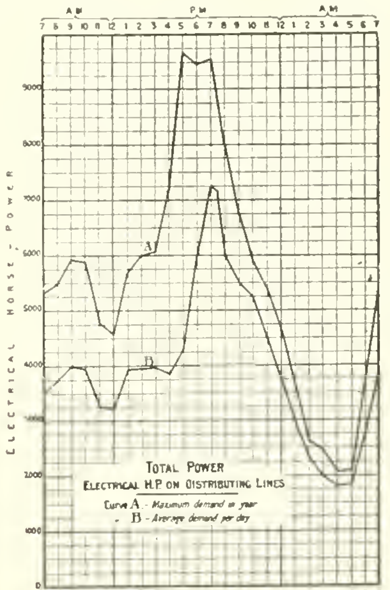
It is well to remember that the apparatus will be called upon to resist much more than the normal pressure, owing to conditions of load to opening of circuits under load, and to lightning, so that a large factor of safety is essential where high voltage is desired.

PERIODICITY.

In former years a high periodicity of 120 to 133 per second was general, being suitable for lighting purposes, and by reason of the high period, transformer costs were low. With the advent of the alternating motor and of long transmission lines, the periodicity dropped to 60, which is now the standard in America. In Europe, however, the tendency is to go even lower, and each maker of apparatus appears to have his own standard.

The lowest possible where incandescent lighting is to be done is 25, for at this alternation the fluctuations are just visible in the light.

The effects of lowering the periodicity are to decrease induction effects (which are always objectionable), simplify and cheapen the motor equipment and to increase somewhat the cost of transformers.



It would appear that for general transmission work, which involves the use of much power for motors, a lower alternation would have met the case speeds better, but as 60 periods has been universally adopted on this continent, it will probably be maintained for some time.

REGULATION.

Owing to the copper losses and induction effects at various loads on the system from the generator shaft to the lamps or motors, the generator voltage must be raised as the load increases. It is very desirable that this increase be kept as low as possible, so that a continual adjustment of the voltage be not necessary, rendering the lights unsteady.

To this end the copper losses, and especially the induction effects, must be kept within bounds. The first involves only the cost of the copper, the latter depends upon the nature of the demands and the relative positions of the copper conductors. The induction of lines and apparatus has an effect somewhat similar to that of the inertia of water in long pipes, and causes the current to lag behind the voltage, necessitating a large output of volt-amperes to produce watts, and, as lines and apparatus must be of sufficient capacity to carry the useless increase of current and the generator to allow for the useless additional volts, an increased capacity of plant is necessary.

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* Paper read before the Canadian Society of Civil Engineers, March 10th, 1898.

These induction effects may have a larger influence on the regulation than the necessary copper losses, and should be carefully watched.

It is well to bear in mind, however, that the increased volt-ampere readings do not represent additional power consumption, as would be the case in direct current, as they have to be multiplied by the cosine of the angle of lag (which is always less than unity) to give the true power.

Poor regulation therefore cuts down the capacity of the plant, and renders it difficult to maintain the voltage constant under varying loads.

Having thus sketched the main points which affect the general working of the plants, the apparatus may be taken up in detail.

DISTRIBUTING STATION.

The reducing transformers necessary for lowering the line voltage to that suitable for the incandescent distribution, arc light motors, and rotary transformers for railway service, must be of the highest grade to stand the high line potential, as well as the increases of voltage to which they may be subjected under certain conditions. Of course the efficiency should be of the highest and the regulation good. As the heat developed is great, an air blast or circulation of cool oil is provided.

The rotary transformers which form such a large part of the load in this case partake both of the nature of alternating motors and of direct current generators. As an alternating current motor of synchronous type they must be self-starting, and in consequence are of either two or three phase.

As a generator they must, at the speed established by the synchronous motor part, give the necessary direct current at the proper voltage for the trolley line, as both the motor action and the voltage generation take place in the one set of armature windings, and as the fields are common to both there is a certain ratio of impressed alternating voltage to direct voltage at the commutator, which is constant, and any change of field strength alters the direct current voltage only indirectly by causing a leading or lagging current in the transmission lines, thus giving more or less volts to the alternating side of the machine.

Owing to this effect of over or under excitation of the rotary upon the line currents, causing them to lead or lag behind the voltage, this apparatus may be arranged to keep the current and voltage of the line in phase, thus doing away with the troubles from lagging currents which so unfavorably affect the system in the matter of regulation. On the other hand, where there is no necessity for close regulation, the line induction is encouraged, and is found useful in overcompounding the direct current side of the rotary automatically, thus giving the rise of voltage with load, so desirable in railway work.

In the present case, if the lighting and railway loads be carried upon separate lines, the latter arrangement is desirable, as the lighting will have good regulation while the railway service will overcompound automatically.

The total load for railway needs being 6,450 E.H.P., and the average from 7 a.m. to 9 p. m. being 3,000 E. H. P., seven units of 1,000 E.H.P. should cover the demands, and the machines in operation should have a good load factor.

For the arc light demands as before stated, eight units would be sufficient. The motors may be either synchronous or induction, the former preferably, as they may be useful in assisting the regulation of the incandescent lighting service by proper excitation, as their loads do not fluctuate.

This apparatus, with the necessary switchboard and instruments for the high potential receiving and lower potential distributing circuits, completes the distributing station equipment.

TRANSMISSION LINE.

The line is usually the weakest link in the chain, being exposed to the weather, and not under that careful supervision which is given to the rest of the plant.

The pole line as a supporting structure must of course be of the solidest to stand the strains imposed, not only by the weight of copper, but in these latitodes by a great weight of ice also, which, if assisted by a gale, will try the best work to the utmost.

Poles of cedar, pine or chestnut of very heavy section are necessary for this work. They should be set in concrete or broken stone and heavily guyed on curves, or in certain positions double poles with heavy cross-arms between should be used.

The insulators for high potential work are universally made of porcelain, as that material weathers better than glass and is not so hygroscopic.

This porcelain should be so thoroughly vitrified as to exhibit a fracture like glass when broken, otherwise it will absorb moisture and break down.

To minimize surface leakage, which, if severe, may burn off the pins, the surface over which it has to take place is made as long and of as small surface as possible. To assist in reducing this leakage, insulators with oil in grooves, over the surface of which the leakage must take place, have been tried and found to work well when the oil surface is clean, but in operation dirt accumulates and troubles ensue, so that the plain porcelain insulator of large insulating surface and high resistance to piercing is now the standard.

The copper circuits are of bare copper, as weather-proof insulation at high voltages is perfectly useless, the cross-section of the copper being of course so proportioned as to give the loss determined upon as suitable for the conditions existing. These conditions depend upon the cost of the power, the amount available and the demands. The loss may be reduced to any extent by the use of more copper, but unless there is a demand for the power saved, which will pay interest and depreciation on the additional cost of circuits, no economy results.

On the other hand, the copper may be reduced and the losses increased, but only within the bounds set by the demands of good regulation.

In practice a loss of 15 per cent. is seldom exceeded, and a very common allowance is from 7 per cent. to 10 per cent.

Several effects manifest themselves in alternating lines which do not exist on those of direct current systems, and they deserve the closest attention in planning the system. While the actual losses in direct and alternating work are about the same under the same conditions, the drop in voltage in the former is a measure of that loss, while in the latter it may be no indication.

In fact, it is possible to so arrange the circuits in some cases of alternating work as to have a greater voltage at the end of the circuit than is generated at the station, but this does not indicate that the line generates power of itself; it simply means that, while the self-induction and capacity of the line and load raises the voltage, much as a water ram in a pipe line raises the pressure, it at the same time throws the current out of phase with that voltage, and the real power is that obtained by the multiplication of the apparent volt-amperes by the cosine of the angle of lag introduced. It is therefore only possible to read the power indications on a watt-meter, which instrument takes account of this angle, while the volt and ampere meter readings which are used to determine direct current power are not reliable for the alternating.

This increase of voltage may under certain conditions become so serious as to endanger the insulation of line and apparatus.

In most cases it is advisable to reduce the induction as much as possible, and to effect this the wires on opposite sides of the circuit are strung as closely together as is consistent with safety, and several wires of equivalent cross section used rather than a smaller number of larger area.

To do away with unbalancing of the phases of the system, the circuits should be strung symmetrically, which is affected in the case of two phase lines by placing the going and returning wires of each phase on the opposite ends of the diagonal of a square, and in three-phase lines by stringing the three conductors at the corners of an equilateral triangle.

As lightning may cause trouble, not only by direct stroke, bu by the accumulation of static electricity upon the lines, means must be provided for getting rid of it safely. To this end, guard lines of barbed wire are strung above the circuits, and these are grounded at frequent intervals.

GENERATING PLANT.

The apparatus in this part of the plant consists of the waterwheels, generator, raising transformers and switchboard apparatus.

Regarding the latter two, the same remarks apply as were made regarding similar apparatus in the distributing station.

As to the generators, their size is usually limited by the powe of the water-wheel units, and their speed by the wheel speed, unless gearing be used.

The usual method of attacking the question with direct-connected units is to arrange for as powerful wheels as is possible consistent with having the proper size units to handle the load properly, and designing the generators to suit the wheels as regards size and speed.

Vertical turbines with the rotating part of the generator revolving in a horizontal plane are usual, but, in several recent plants, horizontal turbines are used direct connected to the generators, which in that case are below the crest of the dam and above the tail-race by an amount determined by the height of the draft tube. The first system introduces footstep bearings, which are always more or less objectionable, but removes the delicate armature windings from chance of damage by water. The second places the generator at the mercy of water-tight bulkheads and stuffing-boxes.

As to the voltage to be generated upon the machines, if raising transformers are used, this is of little consequence unless from a machine designer's point of view, as the transformers will have equal efficiency at any ratio of transformation.

Where the transmission voltage is not dangerously high, it is of course preferable to do away with these transformers, and generate directly on the machine.

In deciding this point it must be kept in mind that the failure of a transformer through the breaking down of insulation is a much less serious matter than that of a generator, which is less likely to occur when that apparatus is of low voltage. Owing, however, to improved types of generators, we may expect to see raising transformers dispensed with in many cases where they would have been deemed indispensable with older types.

In specifications drawn up for the generating apparatus, the following points are strongly insisted upon:

(1) That the heating of any part shall not exceed a certain specified temperature after a certain length of run at full load and an additional time at a certain specified overload.

(2) That the efficiency at full load, three quarters, one half, and one quarter loads, shall be guaranteed by the tenderer and proved by test.

(3) That the regulation of the generator shall be within a certain per cent. at full non-inductive load.

(4) That the insulation of any part of the machine shall not break down under a specified voltage which is high enough to allow of a good factor of safety over the normal pressure.

Although it is impossible to specify limits for these requirements which will suit every case, it may be said generally that the allowable increase of temperatures for large generators ranges from thirty to forty degrees centrigrade. The full load efficiency from ninety-four to ninety-six per cent. The regulation depends upon whether the machine is compound wound or not. In the former case the regulation may be anything for which the compounding is set, and in the latter from three to ten per cent.

The test voltage applied ranges from three to ten times the operative, the former factor for high voltage machines, the latter for low voltages.

The modern generator being either of the inductor or revolving field type, in which the high potential armature windings are stationary, lends itself to high voltage generation, as the insulation spaces may be increased largely without rendering the machines unwieldy, for the reason that the armature wires are distributed over the outside ring where space is more abundant, and the vibration of running, which abrades, and finally breaks down the insulation on the older revolving armature types, is largely absent in the newer machines.

Having sketched in a general way the points to be considered, and determined upon the general features of the transmission, we may take up the figuring of lines, efficiencies and horse-powers to be generated.

To do this, certain assumptions must be made as to the allowable efficiencies of the line and apparatus at various loads, which has been done in the tables below. As regards the apparatus, commercial efficiencies have been assumed which are usual for this class of work, and will be guaranteed by the manufacturers. The line efficiencies are what would be usually allowed, considering the copper as designed for those efficiencies at maximum demand.

	Loads.			
TRANSMISSION (generator to sub-station)	100%	75%	50%	25%
Generators	96	95	94	90
Line	90	92.5	95	97.7
Raising and lowering transformers	96	95	94	90
Total efficiency of transmission	83	83	84	79
INCANDESCENT (distribution to lamps).	Loads.			
Primary distribution at 2,000 volts	96	97	98	99
Large reducing transformers	97	97.5	97	95
Secondary distribution to lamps	97	98	98.5	99
Total efficiency of distribution	91	92.5	93.5	93
ARC LIGHTING (distribution to lamps).				
Efficiency of motor	92			
Efficiency of arc machine.	86			
Efficiency of line distribution to lamps	93			
Total efficiency of distribution	72.6			
POWER CIRCUIT (distribution to motors).				
Efficiency of lines	90	92.5	95	97.5
Efficiency of transformers	96	95	94	92
Total efficiency of distribution	86.4	88	87	89.7
RAILWAY POWER (distribution to motors).				
Efficiency of rotary transformers	96	96	95	90
Efficiency of distributing lines to motors	80	85	90	95
Total efficiency of distribution	76.8	81.6	85.5	85.5

From these efficiencies of line and apparatus the whole power necessary for all the maximum demands may be transmitted at an efficiency of 80 p. c. from the generator shaft to the distributing lines in the city.

The total efficiency at full load from the generator shaft to the lamps, railway and stationary motors, is 68 p. c., and under the average running conditions would be not less than 70 p. c.

These figures illustrate the remarkable efficiency of electrical transmission even on such a mixed and varying load. It will be noticed that at varying loads the efficiencies are not very different, owing to the fact that, while the apparatus falls off, the line increases in efficiency, thus maintaining a balance.

In fact, under light loads the efficiency is higher than under heavy, and is actually higher than given in the totals, because the tables consider the whole plant as operating at fractional load, while in actual running the apparatus would be kept at full load by shutting down units as the load dropped, thus raising the efficiency. The figure of 68 p. c. therefore may be safely taken as the lowest to be met with during the course of the year, and as it holds only for the peak of the load will not affect the average efficiency materially.

The date assumed or calculated for the transmission is given below.

The power is that necessary at the distributing lines to take care of the maximum demands as shown on the curve of total power. The power factor is assumed to be 100 p. c. for the class of load considered, loss in transformers 4 p. c., in line 10 p. c., which is not too high for the peak of the load, as this is what the line is designed for.

Electrical H. P. required at end of transmission line	11,946
Voltage of transmission at end of transmission line	15,000
Periodicity or complete cycles per second	60
Distance transmitted in miles	10
Power factor assumed p. c	100
Loss in transformers p. c	4
Loss in line p. c	10
System of transmission—three phase	

Figuring the transmission on the above assumptions the actual electrical horse power at the generator terminals is 13,623, while the apparent horse power as read by volts and amperes is 13,862. In other words, while the real loss in the transmission is 14 p. c. of the power required at the end of the line, the apparent loss is 16 p. c. This shows a high power factor for the whole system, and is obtained by a non-inductive load on a line well subdivided, and with the wires properly placed.

To illustrate the effect of an inductive load upon the amount of apparatus necessary, another line with a load power factor of 90 p. c. has been figured, the other conditions remaining the same as before. This, while having the same losses as in the first case, requires 17,327 apparent horse power at the generator, necessitating an increase of generating apparatus of 25 p. c., or, in case the plant were installed, it would cut down its capacity 20 p. c., and would decrease that of the distributing apparatus 10 p. c.

Were it not for these induction effects the problem would be as simple as in the case of direct current work, but as it is, they affect the matter to a very great degree, and require the most careful consideration to arrive at even a fair approximation to actual results.

Considering the fact that this power is laid down from the wheels with such simple machinery with but at most one revolving part, and therefore requiring no attention when once started, it is not surprising that electricity should have monopolized the field. The efforts at the present time to transmit to longer distances will be successful in proportion as the knowledge of insulating methods increase; and, from the rapidity with which the present voltages have been attained from the lower formerly prevailing, it is not difficult to forsee the time when this country, which is so rich in water power, will be literally covered with power lines for all purposes. The possibilities in the way of covering an increased territory by raising the voltage may he illustrated by the plant considered above, where, with 15,000 volts and 14 p. c. loss, the power covers a radius of ten miles in all directions. If the voltage were doubled, and the same loss allowed, the radius would be 40 miles, and the territory covered would be sixteen times as great. In other words, the area served will vary as the fourth power of the ratio of increase of voltage. The question of the advisability of transmitting from a distance the natural power available in preference to generation at the centre of distribution by steam power, requires the most careful attention. The cost of the power laid down on the consumer's premises is made up of two items, namely, fixed charges and operating expenses. The first includes interest and depreciation on the plant, the second coal and supplies, attendance, etc. The saving by the adoption of water power is in coal and supplies, and perhaps a small part of the labor, provided the plant cost is the same. Should, however, the cost of the transmission scheme be enough larger than that of the steam to eat up the saving in interest and depreciation on the increased cost of plant, there is nothing to be said in favor of the transmission.

If there is no cheapening of cost the steam plant has the advantage of the greater reliability in lines and apparatus, as no high voltages need be used, and there is no risk of troubles with water power during the winter sech as exist to a greater or less extent in this climate.

In many cases, however, where the water power improvement can be made with small outlay per horse power rendered available, the gain may be large. It is not so large, however, as seems to be the idea of the public, which considers a water power as capable of producing power for nothing, entirely ignoring the capitalization necessary for development.

The transmission and utilization of electric power has got beyond the experimental stage, and is not now surrounded with that mystery which used to obscure the financial facts, and the more it is considered as a commercial article depending upon the laws of supply and demand for its existence, the more will its usefulness become apparent to the consumer and its financial security appeal to the capitalist.

SELECTION, HANDLING AND CARE OF BELTS.

NEARLY every engineer has one or more belts under his care, and from the condition many of them are in it would seem that a word of advice as to their selection and care would not be amiss, writes Charles H. Garlick, in Lumber.

If, when in need of a belt, the engineer would, instead of simply ordering a certain number of feet of a certain width and thickness, try the experiment of personally selecting the same for the work which he wishes to have the belt do, and then use the same care in placing the belt in use that he does in starting any other piece of new work or new machine, much better results would be obtained than is usually the case. There are many, very many, rules and formulæ for ascertaining the width of belt necessary for transmitting a certain amount of power. No two of these rules agree, because there are so many conditions that enter into the problem that no hard and fast rule can be used.

From the writer's experience he prefers to use the following formula, which in ordinary cases will be found nearly correct:

$$W = \frac{\text{H.P.} \times 5{,}500}{\text{Velocity} \times \text{contact in feet.}}$$

This is single thickness. For double thickness belts:

$$W = \frac{\text{H.P.} \times 3{,}600}{\text{Velocity} \times \text{contact in feet.}}$$

Or the width of the belt can be found by multiplying horse power to be transmitted by 3,600, and dividing the product by the number of feet of the belt that will pass over the pulley per minute, multiplied by the number of feet of belt in contact with the driving pulley. A very good "rule of thumb" for single belts is: Belting 1 inch wide having a velocity of 600 feet per minute, will transmit 1 horse-power.

It should be borne in mind, however, that the width of the belt necessary to transmit a certain horse power depends on several conditions, one of which is the tension of the belt. When a belt is too tight there is a constant waste in journal friction, and when too loose a great loss in efficiency from "slip." A belt should be procured that will deliver the power required in a fairly slack condition.

Between a slow speed and a wide belt and high speed and a narrow belt, choose high speed and narrow belt wherever practicable, in designing for the transmission of power. A velocity of belt up to a mile a minute is practicable and advantageous.

In taking lengths for belts, where it is not convenient to measure with a tape-line the length required, this rule will be found of service: Add the diameters of the two pulleys together, divide the result by 2, and multiply the quotient by $3\frac{1}{4}$; add the product to twice the distance between the centres of shafting, and you have the length required, very nearly.

In buying, be sure that the leather is oak tanned, has a smooth, polished surface and a fine fiber. It is a good idea to have the belt unrolled and examine it to see that laps are thoroughly made and fastened. Note whether the belt is of the same uniform thickness throughout its entire length, also that the belt is pliable and not harsh and brittle. Note if possible whether the hides which make up the belts are of uniform thickness, or whether the thickness of belt is obtained by splitting the hides, and if the latter is the case reject it.

As to whether you purchase single or double belts, it may be said that single belts can be used successfully up to twelve or fourteen inches in width, but where more power is required than a belt of this width will transmit under the conditions that exist in your plant, belts of double thickness should be used. With single belts, care should be taken to have them of ample width, so that there need be no necessity of having them tight. Double belts should be used when a great strain is to be put on the leather, or for slow speed, or when a belt is to be run at one-fourth turn; belts which you are called upon to shift frequently, or which are to run on vertical shafts, should be double.

As to the respective value of rubber or leather belts: Rubber belts do not cost as much as leather, nor do they, under favorable conditions, last as long. They cannot be used in places where the belt rubs, nor where it becomes necessary to shift often; neither can they, as a rule, be run successfully as cross belts. They should not be used where oil is likely to drop on them, nor where they will freeze. They usually last longer than leather belts in damp localities. Rubber belts will adhere to pulleys better than leather. When a rubber belt commences to wear out it is almost impossible to do anything to repair it. Having purchased a new leather belt, it should, if time will permit, be stretched before being placed in work. This can be done in a variety of ways, depending on the width and length of belt and the time at the engineer's disposal. One way is to stretch it over two pulleys placed some distance apart, and attach weights to either end of the belt. During the stretching period a little oil should be applied to the leather.

Belting for electric lighting machinery must have some characteristics all its own. For ordinary machines a positive steady motion. is not absolutely necessary, but with an electric plant it is different. It is necessary for the belt to be endless and of a uniform thickness. Even so small a thing as uneven laps will cause a slight but constant jumping or flickering of lamps. With most dynamos as built to-day provision is made for the purpose of taking up any stretch that may occur in a properly-constructed, designed and well-stretched belt. Yet, should it become necessary to shorten one of these belts, it may be done by using clamps. Care should be taken and the laps made as long as possible, and sufficient time given the work before removing the clamps.

While endless belts are to be preferred for almost all work, yet in many places the time, care and experience required to join them is such that recourse is had to the more convenient method of lacing or fastening with clamps or hooks, and of all the different methods the writer has been more successful with and prefers lacing. But even such a simple piece of work as that of joining a belt by means of lace—a narrow strip of rawhide—is sometimes done in a manner to very materially reduce the life of the belt, and very seldom is sufficient time or care given to this work. The ends of the belts should be cut exactly square, using an ordinary tri-square for this purpose. Punch the holes exactly opposite each other in the two ends of the belt to be joined. It is best to use an oval punch for this purpose, the longest diameter of holes being parallel with the belt. Two rows of holes should be made in each end of the belt, the same being staggered. The edges of holes should all be at least seven-eighths of an inch from the end or side of belt ; be sure and keep the belt square, and lace both ends equally tight. The laces should not be crossed on the side that runs next to the pulley, but on that side laces should run parallel with the belt. Fig. 1 shows the inside of the lacing, or the side that should run next to the pulleys, and Fig. 2 shows the outside of the lacing, the side that is not in contact with the pulley.

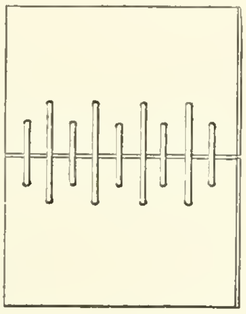

FIG. 1—Side of lacing running next to pulley.

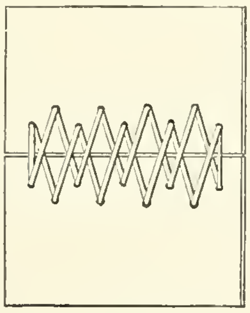

FIG. 2—Outside of lacing.

In placing the belt on pulley, put it on so that pulley in slipping will run with, and not against, splice or joint. While authorities differ as to which side of the belt should be placed next to the pulley, the writer's experience has been that the best results are obtained when the grain side is placed next to the pulley. Experience has proven that it will drive more than when the flesh side is in contact with the pulley, and that the belt will last longer.

If the belt is to be crossed, do not put it on in such a manner that at the places of passing joints or laps will meet and be turned up and ruined in a short time.

How to place a belt on a pulley is one of the little things one can become an adept in only by practice. If the belt is a heavy one and the pulley runs at a high speed, it is best to slow down the machine, then place the belt on the loose pulley or the pulley at rest. Secure a firm footing, and with the right hand slowly work the belt up to top of pulley, when a quick jerk down or up, according to the direction the pulley is running, will throw the belt on. When the belt is heavy, or the operator lacks experience, it is best to shut off the power, place the belt on pulley as far as possible, then take a small leather belt, or even a rope, double it, slip one end through the arms of the pulley and around the belt and rim of the pulley, and the other end through the loop formed by the double of the small belt or rope ; then stand on the floor on the opposite side and draw on the small belt or rope, when the belt will be drawn to the rim of the pulley. When the machine is placed in motion, the belt may be slipped on without any trouble ; then, by letting go of the small belt or rope when the belt is on the pulley, the noose will be undone and the small belt will be free.

If the belt does not stay on the pulley, do not erect guards to keep it on, as they are an eyesore, and soon wear the belt out. Besides, the guards simply cure an effect, while the cause remains. The cause may be that the pulley is not in line, or that the belt is not joined squarely, or one side is stretched more than the other. Sometimes a belt running at high speed, transmitting scarcely any power, will wave from one side of the pulley to the other, and if a load is not thrown off will eventually come off. In places where it was not convenient to either put in pulleys of larger diameter, or even wider belts, and where the use of resin, oil and other adhesive matter would not cause the belt to adhere to the pulley, the difficulty has been overcome by running a narrow belt, drawn tightly, with ends laced, over the main belt. In one place where occurred a continual slipping of a ten-inch belt, the writer took an old two-inch belt, placed it upon the ten-inch, and the two belts carried the load for years without trouble.

According to Electrical Engineering, of Chicago, the total number of telephones in use in various countries has been tabulated as follows : Province of Angola, 200 ; Austria, 20,000 ; Australia, 2,000 ; Bavaria, 15,000 ; Belgium, 11,000 ; British India, 2,000 ; Bulgaria, 300 ; Cape of Good Hope, 600 ; Cochin, China, 200 ; Cuba, 2,500 ; Denmark, 15,000 ; Finland, 6,000 ; France, 35,000 ; Germany, 140,000 ; Great Britain, 75,000 ; Holland, 12,000 ; Hungary, 10,000 ; Italy, 14,000 ; Japan, 3,500 ; Luxemburg, 2,000 ; Norway, 16,000 ; Portugal, 2,000 ; Roumania, 400 ; Russia, 18,000; Senegal, 400; Spain, 12,000; Sweden, 50,000; Switzerland, 30,000 ; Tunis, 300 ; United States, 900,000 ; Wurtemberg, 7,000. These give a total of 1,402,100.

SPARKS.

H. C. Baird & Son will probably put in an incandescent light plant at Parkhill, Ont.

The Halifax Electric Tramway Company has declared an annual dividend of six per cent.

A movement is on foot at Ottawa to secure a popular vote on the question of operating the street railway on Sundays.

The sum of $20,000 is to be expended for the continuation of the telegraphic service on the north shore of the St. Lawrence.

The C.P.R. are equipping new telegraph offices in Winnipeg, under the superintendence of Mr. W. J. Camp, the company's electrician.

The Royal Electric Co. has installed a 15 h.p. Stanley induction motor for the Montreal Water & Power Co., which is to be used for pumping purposes.

The Common Council of St. John, N. B., has authorized the Safety Board to make arrangements for lighting the city at the expiration of the present contract.

The Royal Electric Co. has secured an order from the corporation of Joliette for a 120 k.w. S.K.C. generator, with full complement of transformers, etc.

The city engineer of Toronto is preparing specifications for an electric plant to be placed in the new municipal buildings, and at an early date tenders for same will be invited.

The Montmorency Power Co., of Quebec, has made an addition to their plant by the installation of another 600 k.w. S.K.C. generator, which was purchased from the Royal Electric Company.

The Napanee Water & Electric Light Co. have gone into the incandescent lighting business, and are now serving lights from their new S.K.C. plant recently installed by the Royal Electric Co.

The Niagara Falls Park and River Railway Company have completed the work of laying their tracks on the new steel arch bridge at Niagara Falls, and the first car was run over it on July 1st.

The Galt and Preston Electric Railway Company have asked the towns of Berlin and Waterloo for a bonus of $40,000, in consideration of connection by their railway with the C.P.R. The by-law to grant $12,000 has been carried by the town of Waterloo.

Messrs. Miller Bros. & Toms, of Montreal, have placed an order with the Royal Electric Company for two 40 h.p. direct current motors. The machines will he direct connected to two Quimby screw pumps, and will be used for the operation of elevators, etc.

A number of Montreal gentlemen have purchased a mountain at St. Bruno, Chambly district, about ten miles from Montreal, and purpose expending a large sum of money in improvements. An electric railway from Montreal to St. Bruno is included in the scheme.

The Sherbrooke Gas & Water Co. has closed a contract with the Royal Electric Co. for two 240 k.w. S.K.C. generators. This is the fifth order that has been placed with the Royal Electric Co. for S.K.C. machinery by the Sherbrooke Water & Gas Co. within the last two years.

It has been decided not to extend the electric railway system of Quebec to Montmorency this year, but everything will be got in readiness during the winter to change the motive power of the entire railway from Quebec to Cap Tourment from steam to electricity next spring.

The recently-formed Ottawa Electrical Association have elected the following officers: Hon. president, T. Ahearn; president, J. Murphy; vice-president, B. Marchand; secretary, E. Bailey; treasurer, B. Nolan. Executive Committee: Messrs. W. G. Bradley, E. J. O'Reilly, P. Grimes and J. Johnson.

On Queen's birthday an electric railway car with sixty tired holiday makers on board was proceeding from Vancouver to New Westminster, B.C., at a rapid pace when an axle broke and the car completely overturned. The 60 occupants were jumbled together in one mass as the car still on its side ploughed along the side of the track. Miraculously as it seems, nobody was killed, though several people were more or less injured.

John Philip, of Grand Valley, Ont., has secured a franchise from the corporation of Arthur for the supply of electric light in that town. He will generate the current at Grand Valley from his S.K.C. plant, and with the aid of step-up transformers transmit it to Arthur, a distance of 16 miles. Mr. Philip will illuminate the streets of Arthur with alternating current arc lamps. The order for the complete work has been placed with the Royal Electric Co.

The adjourned annual meeting of the shareholders of the Hamilton, Chedoke & Ancaster Electric Railway Company was held on June 10th. The reports showed that about $30,000 of stock had been placed. The company wish to dispose of $10,000 more before beginning active operations. Following are the new directors and officers: Messrs. E. A. Clifford, president; Jacob Shaver, vice-president; E. Kenrick, auditor; E. Henderson and W. R. Clarke. Mr. W. F. Walker, Q.C., was re-appointed secretary-treasurer and solicitor.

As sources of energy, it has been proposed to use the peat bogs of North Germany, and what is now practically waste land is expected to become available for manufacturing on a large scale. The bogs of the Valley of the Elms, for example, cover some 13,000 square miles, and the proposition has been made to erect in this section a 10,000 horse power electric plant which would consume annually some 200,000 tons of peat, equivalent to the amount yielded by 200 acres. One acre of bog averaging ten feet in thickness contains abont 1,000 tons of dried peat, and the amount produced on 430 square miles would afford as much heating power as the 80,000,000 or more tons of coal annually mined in Germany. The proposed plan contemplates using the energy on a canal and in the manufacture of calcium carbide.

At the annual meeting of the Ottawa Electric Light Co., held on June 28th, Mr. T. Ahearn was elected president, Hon. E. H. Bronson vice-president, and Mr. J. W. McRae managing director. The revenue for the year was $159,583.54 from ordinary sources of light, heat and power, this amount being an increase over previous year of $5,659.12. The gross expenditure for the year was $109,117.61, an increase of $10,293.58. The report recommended that no dividend be paid for the past half year, but that $12,520 be placed to the credit of rest account, also the whole balance of $24,368.03 to the credit of the profit and loss account. It may be stated that the company paid four per cent. for the first half year and has been paying eight per cent. annually lately, but the directors conclude that proper allowances have not hitherto been made for depreciation and renewals.

Some particulars have come to hand of the project of harnessing the Rio Cobre, in Jamaica, by the West India Electric Company, of which Mr. Henry Holgate, late of Montreal, is manager. The works are situated near the great tunnel at Boy Walk, at which point the river is 160 feet wide. The dam will stretch from one bank to the other, to be embedded in the solid rock. The concrete and masonry sunk in the rock of the river bottom will go ten feet below the water, and above the water the walls of the dam will rise some nine feet or thereabouts. The water is taken in from the dam by a pipe eight feet in diameter. The pipe will convey about 20,000 cubic feet of water, or about 120,000 gallons, a minute to the power works. The pipe will be provided with a steel valve to regulate and control the supply of water to the power house. The pipe which leads from the dam to the power house will run alongside the river for one mile and a quarter. The power house will be built entirely of steel and concrete, the steel work alone weighing 250,000 pounds. The river in its course for one mile and a quarter drops about 47 feet, which, added to the foot of the dam, amounts to 56 feet, which will be the fall of the pipe in its course to the works.

The Montreal Transportation Company have just completed a new elevator at Kingston, Ont., the power house of which is built of brick, 48 × 52 feet. There is a brick chimney, 136 feet high, with a four foot six inch flue. It stands on a thirteen foot six inch square base, running to the height of twenty feet. It then points into an octagon, and from the height of twenty-five feet from the ground the remainder is circular. The engine in the power house is a Corliss tandem compound, with cylinders twenty inch, forty inch and forty-eight inch stroke. There are also an improved Blake twin vertical air pump and condenser, a 600 horse power heater, supplying water to the hoiler heated to 210 degrees Fah.; an outside packed boiler, plunger pump, 8 × 5 × 12 feet, for feeding the boilers, and a battery of three boilers, each 16 × 72 inches. There is also a fire pump with a capacity of 750 gallons per minute. The power house is provided with an electric lighting plant. An 8 × 10 inch Ideal engine is direct connected to a dynamo operating at 110 volts, made by the General Electric Company, of Peterboro'. This dynamo lights over 200 sixteen candle power incandescent lamps in the elevator, power house and office, besides twelve special arc lamps on the wharf, being long burning lamps on the incandescent system.

ELECTRIC RAILWAY DEPARTMENT.

THE HULL ELECTRIC RAILWAY.*

By F. C. Armstrong.

At the present stage of electric railway development, there is no subject more attractive to the electrical engineer, or which more seriously demands the consideration of the steam railroad manager, than the possibility, as yet mainly undefined, of the profitable conversion to electrical operation of existing roads operated by steam. In the street railway field, the success of electric traction has been of the "veni vidi vici" order; the mule, the horse and the cable are in process of becoming memories within the short stretch of less than one decade. A similarly successful attack on the larger field at present occupied by the steam locomotive, is another matter. For one thing, the steam locomotive is admittedly doing its work and doing it well and economically; for another, the transmission factor is at present, working it out in any way we choose, a serious limitation of range in the substitution of electricity for steam, even in suburban practice.

The work of the past two or three years, however, has established certain important points, even to the mind of the most prejudiced steam railroad manager. The B. & O. installation at Baltimore has demonstrated the possibility of constructing and operating electric locomotives capable of exerting a greater tractive effort than the most powerful steam locomotives anywhere in use. The work on the New York, New Haven & Hartford branches, on the elevated roads in Chicago and elsewhere, and on the important suburban lines which control the local business centering in Cleveland and other cities, has shown clearly the commercial advantages to be gained by the conversion to electricity where quick and frequent service is demanded over distances up to 25 and 30 miles. There is no doubt that even with our present transmission limitations, a very large field exists for the electrical equipment of suburban and branch lines of steam roads, where the present or possible business is of such a nature that its full development can only be attained under the special conditions of operation rendered possible by the use of electric traction. An excellent example of the successful realization of this possibility is found in the case of the Hull electric railway.

The Hull electric railway runs from Hull, a city of 15,000 inhabitants, lying immediately across the river from Ottawa, the capital of the Dominion of Canada, to Aylmer, a village of 2,500 inhabitants.

Until June, 1897, the main line was known as the Aylmer branch of the Canadian Pacific Railway, connecting at Hull with the C. P. R. and at Aylmer with the Pontiac & Pacific Junction, a road running north some 70 or 80 miles, through the county of Pontiac. While operated as the Aylmer branch of the C. P. R., its business consisted of transferring passengers and freight from the Pontiac & Pacific Junction road to the Canadian Pacific main line, a considerable freight business in hauling lumber from some large mills, located midway at Deschenes, and also what passenger trafic existed between Aylmer and the city of Ottawa. Its operation under these conditions was unprofitable, and the Canadian Pacific Railroad was quite willing, when approached by capitalists interested in lumber mills and water power along the line, to lease the property, consisting mainly of 10 miles of single track, for $5,000 per annum. The equipment of the road, for electric traction, was immediately proceeded with, the power house being located at Deschenes, midway between Hull and Aylmer, where an excellent and cheaply developed water power was available. The gentlemen interested in the property are among the most prominent in financial and business circles in Ottawa, and they have not spared any expenditure necessary to put the road in the best possible shape to handle the business and pay a return on the money invested.

Hull Electric Railway—Electric Freight and Passenger Train.

The total length of track, including sidings, is 26 miles, the main line running from Hull through Deschenes and Aylmer to Queens Park being double-tracked throughout. It was intended at first to operate the line as a single track road with turnouts, but this was found not to be feasible on account of the number of train units. The right of way was therefore purchased outright from the C. P. R. and a second track was laid down. The rails are of steel, weighing 56 lbs. to the yard; and the ties cedar, of the standard dimensions, and laid 2,640 to the mile. On the whole line the number of highway crossings at grade is three, one overhead and one grade crossing being made over steam roads. The heaviest gradient on the portion of the line used for freight is 2 per cent.; there is one short grade of 204 feet to the mile, on the branch line running to Queens Park, over which there is no freight service.

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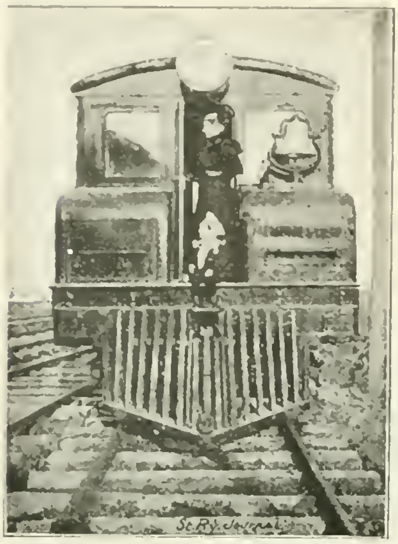
* Reproduced from the Street Railway Journal, New York.

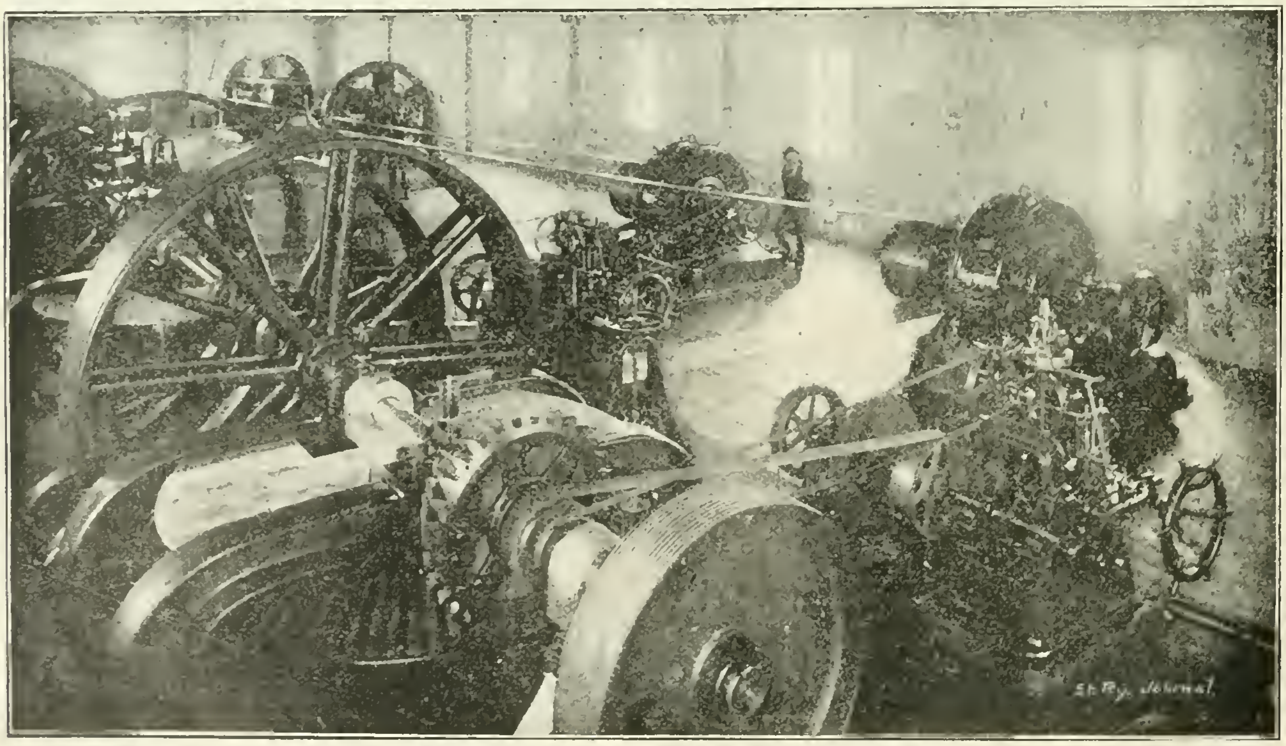
POWER HOUSE.

In the power house located at Deschenes there are at present installed six 60 ins. new American vertical turbines, built by Kennedy & Sons, developing at the normal head of 9 ft. 6 ins. 1,000 h.p., the jack shaft speed being 165 r.p.m.



Hull Electric Railway—End Views of Locomotive (Summer and Winter.)

The railway generators consist of two steel frame machines, of the Canadian General Electric Company's standard type, having a capacity of 325 k.w. each. Power is also furnished from the jack shaft to operate two 150 k.w. monocyclic alternators, from which current is furnished for the extensive lighting business of the Deschenes Electric Light Company in Hull and the city of Ottawa. The difficulties usually experienced in speed regulation with water power are largely overcome by the use of an artificial load, thrown on and off the generators by a very simple and positive method designed by the electrical engineer of the company, J. E. Brown, the use of water wheel governors alone not having been found sufficient to give a reasonably constant speed under the violent load fluctuations experienced when operating the electric locomotives.



Hull Electric Railway—Interior of Power Station.

CAR HOUSES.

The car houses located alongside the main line at Deschenes are of stone, and consist of two buildings, each 150 feet long by 70 feet wide; each of these buildings contains four tracks, with pits continued throughout their full length; space is also given for an excellently equipped machine shop and for a tool house, store room and draughting room. A swinging crane is provided over the working pit and hydraulic jacks for handling the motors in the pits themselves.

ROLLING STOCK.

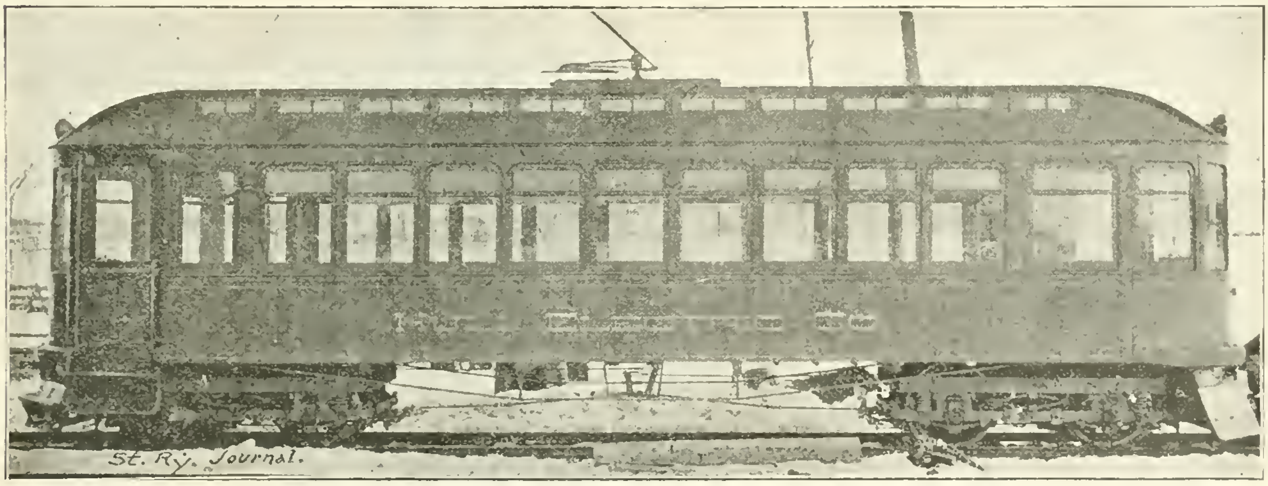
The rolling stock consists of thirteen double truck motor cars, of which four are closed and nine open; also of two single truck 21 foot cars for handling the local traffic in Hull. Four 13-bench open trailers are being added to the equipment this summer. The double truck closed cars are 40 feet 2 inches in length over all; vestibuled at both ends and finished both inside and out in solid mahogany; a special feature in the design of these cars is the use made for an observatory and smoking room of the vestibuled compartment at each end. The equipment for the double truck cars consisted originally of two 50 h.p. motors, but in practice these have not been found entirely satisfactory. The present standard equipment, both for the open and closed cars, consists of four G.E. 1000 motors, geared to run at 25 to 30 miles per hour. This has been found by experience to be an admirable equipment for work of this class. The trucks used are of the Blackwell, Taylor & Brill make.

In addition to the rolling stock mentioned above, which is required for the purpose of handling the passenger traffic, the company operates two electric locomotives, and an express, baggage and mail car, consisting of an ordinary closed body, mounted on double trucks, and equipped with two G. E. 1200 motors. The company has also a Ruggles rotary snow plough, and a snow plough manufactured by the Canadian General Electric Co. A most efficient aid in fighting snow, and one which has proved most effective during the past winter, even with storms that have stalled the steam roads for several days, is the snow plough on each car, designed by Mr. Brown, and shown clearly in the engravings.

Of the two locomotives, both of which are in everyday use on the road, the first, which has been in operation since its starting up, two years ago, consists of a 22 ft. 8 ins. body mounted on heavy Blackwell trucks and equipped with four G. E. 1200 motors, geared to run at 20 miles per hour. The operation of this locomotive has been exceedingly satisfactory, its usual load being five or six loaded freight cars. Locomotive No. 2, which was placed in operation last summer, is a much more powerful machine, the body being 26 ft. in length and the equipment consisting of four G.E. 51 motors, capable of developing 80 h.p. each, mounted on McGuire "L" trucks with steel-rimmed wheels. Several improvements in the form of the body have been introduced, the most important being the lengthening of the cab and the placing of a door and passage at each end. The latter was rendered necessary by the inconvenience and danger experienced in handling the trolley where the ends are of the standard sloping style of the No. 1 locomotive. The No. 1 locomotive is provided with hand brakes only. The No. 2 machine is equipped with Standard air brakes, operated by a motor-driven compressor placed in the cab. The larger locomotive has been found in operation to be an exceedingly powerful machine, as many as thirty-three freight cars having been handled on a shunt; the ordinary load is twelve loaded freight cars. The car bodies and locomotive bodies were manufactured at the shops of the Canadian General Electric Company, by whom the entire electrical equipment used on the road has been provided.

The following statement shows the amount of freight carried, and the nature of the business done by the No. 1 locomotive during its first season. This, it should be remembered, was the first in which business was done and did not include twelve months of time, as the line was not put in operation until during the spring months. A very large increase in this business took place during the second season, rendering necessary the placing in service of a second and larger locomotive.

600 lbs. flour	60 tons.
88,200 bushels of grain	18,000 "
1,500 live stock	500 "
17,020,000 feet of lumber	25,350 "
2,000 cords of fire-wood	3,000 "
Manufactured goods	408 "
Total	47,318 tons.

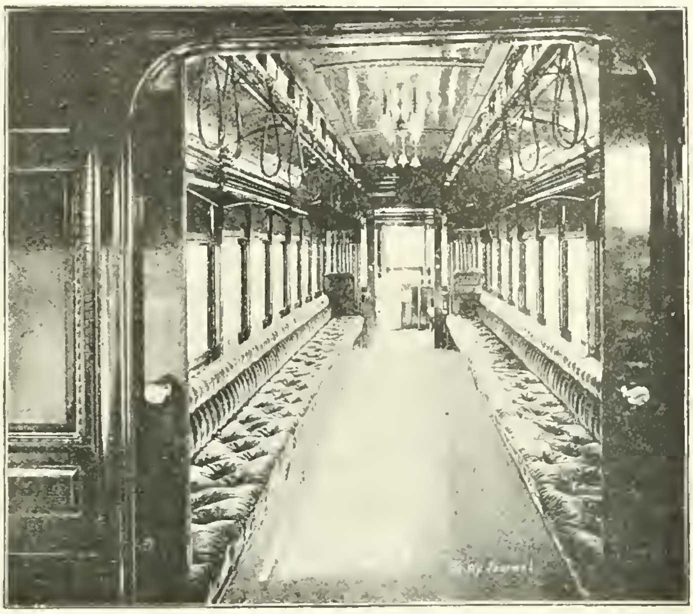


Hull Electric Railway—40 ft. Double Truck Electric Car.

An important feature in connection with the handling of freight is the low cost of locomotive repairs as compared with a steam locomotive. An additional and important saving is the greatly reduced cost for cleaners and attendants in the car-house.

The following are the rates of fare charged: Regular tickets, three for 25c.; white tickets (good between Aylmer and Deschenes, Tetreau and Hull, from 6:30 a.m. to 7:30 a.m., and between 5:00 p.m. and 6:30 p.m.), eight for 25c.; red tickets, good between the stations mentioned on Sunday only, eight for 25c.; commutation tickets, giving sixty rides per month, $5 for the first month, $4.60 for the second month, and so on down to $3 for the sixth month, and every subsequent month up to the twelfth; family tickets, 50 rides for $4; school tickets, good only in Aylmer and Hull, forty tickets for $1.

The officers of the road are as follows: President, Alexander Fraser; vice-president, W. J. Conroy; secretary, W. R. Taylor; mechanical and electrical engineer, J. E. Brown; purchasing agent, E. Seybold; trainmaster, C. Aird.



Hull Electric Railway—Interior of Car.

It is said that the Bell Telephone Company have decided to install a metallic circuit in St. Thomas, owing to the interruption by the operation of the street cars.

The ratepayers of Hamilton have voted in favor of extending the franchise of the Hamilton Street Railway Company for fifteen years, or until 1928. The vote was strongly against the corporation assuming control of the road.

Tenders are invited up to August 30th for supplying an incandescent electric light plant for the corporation of Beeton, Ont. Mr. John Galt, C. E. and M. E., is consulting engineer, and Mr. W. H. Mitchell chairman of the electric light committee.

The Charlottetown, P.E.I., Light and Power Company held its first general meeting recently. Mr. L. L. Beer was chosen president and Mr. Henry R. Loidly, C.E., engineer and manager. Mr. Lordly will go to England to consult with parties who control a new electric motor, to be used for street cars.

A company, known as the Metropolitan Electric Company, and represented by Mr. T. Lindsay, has made application to the city council of Ottawa for permission to sell electric light and power within that city. The company offer to supply electricity for one cent per ampere hour, with a discount of 40 per cent., and also a further discount of 12 per cent. for cash within 15 days, off the lowest net meter price. It will be remembered that recently the Deschenes Electric Company were refnsed a similar privilege as that asked by the Metropolitan Company.

SPARKS.

A company has asked the Dominion government for a subsidy for an electric railway from London, Ont., passing through Stratford, Arkona and Thedford to a point on the Georgian Bay.

An English syndicate has secured a controlling interest in the New Westminster and Burrard Inlet Telephone Company, which operates an extensive system, extending to the United States.

An important contract has recently been made between the Dominion Cotton Company and the Royal Electric Company, whereby the former are to install electricity as the motive power in their works. The contract calls for 1,500 horse power from the Chambly works, with the option of increasing it to 3,000, the contract to run for twenty years.

Experiments are being conducted on a system for telegraphing without wires between Lavernoch Point and Flat Holm Island, in the British Channel, a distance of 3½ miles. The Morse code of signals is used and the messages are read by sound. It is stated that 40 words per minute have been signaled across and read without any difficulty. The system is the invention of W. H. Preece, engineer-in-chief of the English General Post Office.

The Montreal & Southern Counties Railway Co., which obtained a charter last year, was given power at the last session of parliament to extend its operations to the counties of Beauharnois, Chateauguay, Huntingdon and Napierville, and to increase its bonding powers rrom $20,000 to $25,000 a mile. Authority is also given ts sell electricity for light, heat and power. Mr. Albert J. Corriveau, of Montreal, is the promoter of the scheme.

Mr. R. H. McCollum, son of Rev. J. H. McCollum, of Toronto, has invented an automatic brake for street cars, which was recently tested, with very satisfactory results, by the management of the Toronto Street Railway. The function of this new brake is to automatically work upon the trailer, which at the present time is acted upon by the old hand brake. Owing to the many duties of the conductor, the trailer breaks are seldom used, and the car rushes forward with such force that the trolley is driven ahead, despite its acting brake. With this novel brake, however, the car may be stopped, even with a loaded trailer behind, in a distance no greater than its own length.

Municipal trading in electric lighting fixtures has been declared to be beyond the powers of municipal corporations in England in the absence of legislative authority to that effect. The question arose, according to the London "Surveyor," at Leicester, where the town brought action to recover some $25 from a tradesman to whom it had sold lamps and other fittings. The court decided that since the goods had been furnished they must be paid for, but that the plaintiff should bear the costs, and had clearly exceeded its powers. The town did not restrict its trade to patrons of its lighting plant, which might have altered the case, especially the supplying of lamps. The reasoning used in this decision would doubtless hold good on this side of the water.

Prof. Callendar, recently of the staff of McGill University, Montreal, has designed a platinom electrical resistance thermometer, capable of measuring temperature to the ten-thousandth part of a degree. The extreme delicacy of the instrument makes it a valuable aid in securing accurate observations of the temperature of lake and river water during the various seasons of the year, as no thermometer is available for such minute measurements. A long series of observations of the temperature of the St. Lawrence was made last winter by the McGill professors, in all of which the new instrument was used. By its aid it has been found that the greatest deviation that takes place in the winter during the ice-forming period, is only about one-thousandth part of a degree.

Mr. Henry Symons, Q.C., has had estimates prepared by eminent English engineers on the construction of the proposed works of the Welland Power and Supply Canal Company. This project involves the construction of a canal from the Welland River to the brow of the mountain at Thorold, a distance of 8 miles; the construction at Thorold of a power house, and from Thorold to Lake Ontario, a raceway by which to carry water into the lake. The estimate for the machinery to generate 100,000 horse power is £125,000; for transmission line to Toronto at a voltage of 10,000 and delivery of 50,000 horse power, £801,600; for excavation and other work connected with the undertaking, £1,525,062. The total estimate therefore amounts to £2,452,162, or roughly speaking, $12,000,000. If the amount to be delivered in Toronto is reduced to 20,000 horse power, the project would cost $1,000,000 less.

JAMES MILNE

Mem. Can. Soc. Civ. Eng. Late Gen. Sup't. Toronto Incandescent Light Co. Teacher Electrical Engineering, Steam and Steam Engine, Toronto Technical School.

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The directors of the Bell Telephone Company have decided to increase the capital of the company from $3,168,000 to $3,900,000.

John D. Banks, an engineer, of Toronto, committed suicide recently by inhaling gas. Deceased was at one time engineer at the Globe office.

The Western Electrical Construction Company recently commenced business at 210 William avenue, Winnipeg. W. T. Steward and F. Yates are the chief members.

The shareholders of the Montreal Island belt line railway authorized the directors to issue new bonds to the extent of $380,000, and to cancel and redeem the old issue of $300,000.

According to the daily press the Toronto Railway Company has entered suit against the Siemans & Halske Electric Co., of Chicago, for $25,000 for breach of warranty of a generator.

The electric light plant at Tilbury, Ont., owned by Mr. R. H. Smith, was destroyed by fire on July 18th last. The loss is about $4,000, two-thirds of which is covered by insurance.

The town of Brampton, Ont., has given a contract for electric street lighting to Pearen Bros., at $50 per lamp per annum. The latter will install an arc dynamo and probably an incandescent dynamo.

The city council of St. Thomas, Ont., has granted a charter to the Peoples Telephone Co., capital $60,000, to construct a telephone system in that city. The president is Mr. Joseph Mickleborough.

The corporation of Thorold, Ont., is advertising for tenders for the extension of the electric light plant, subject to the passing of a by-law authorizing the necessary expenditure. The estimated cost of the work is $7,161.

A company has been formed, composed of Sir William Van Horne, Senator Proctor, of Vermont, Mr. Alger, secretary United States navy, and others, to develop the water power at Grand Falls, N. B., and transmit electric power north to River du Loup and south to Woodstock.

J. D. Kelly, a lineman employed by the Bell Telephone Co. at Peterboro, Ont., while at work aloft on Charlotte street, came into simultaneous contact with a live electric power transmission wire and a grounded telephone wire, mounted on the same pole, and was instantly killed.

The Bell Telephone Co., of London, Ont., are stated to have responded to the challenge of the Peoples Telephone Co., and lowered their rates. Telephones in residences have been reduced from $25 and $30 to $20 a year, unlimited, and for doctors' and dentists' offices from $35 to $25.

TRADE NOTES.

The Babcock & Wilcox Company, of Montreal, have secured the contract for boilers for the new civic electric light plant at Granby, Que.

The Electric Construction Co., London, Ont., are installing a 6 h.p. motor and pump for the corporation of Burlington, Ont., to pump the water for street sprinklers.

W. Doherty & Co., organ manufacturers, Clinton, Ont., have installed two 15 h.p. multipolar type motors made for them by the Electrical construction Co., of London, Ont.

The Robb Engineering Co., of Amherst, N. S., who put in five of their Robb-Armstrong engines for the Halifax Tramway Co., are now putting one in the Union street station of the St. John street railway. It is a 300 horse power tandem-compound, side crank engine, medium feed. The Robb Company are now shipping engines to customers on the other side of the Atlantic. Three have been sent to the Isle of Man, for use by a tram company, and three more to Spain, and a seventh one will be shipped to Liverpool shortly.

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VOL. VIII. SEPTEMBER, 1898 No. 9.

LONG DISTANCE TRANSMISSION PLANT OF THE WEST KOOTENAY POWER AND LIGHT COMPANY.

THE falls of the Kootenay river, known as Bonnington Falls, in British Columbia, that have for some long time been an attractive field for the development of power, have now been harnessed and the power transmitted electrically to Rossland, the mining centre of the Kootenays, situated 30 miles distant.

Bonnington Falls is an ideal site for such a plant, the river at this point being 400 feet wide, while the water rushes over a high granite cliff, having a fall of 50 feet. At this point the Selkirk mountains rise to an elevation of over 3,500 feet above the sea level, the altitude of the river itself being about 2,200 feet, and the beautifully snow-capped peaks of the rugged range form one of the many charming and picturesque features that surround this extensive enterprise.

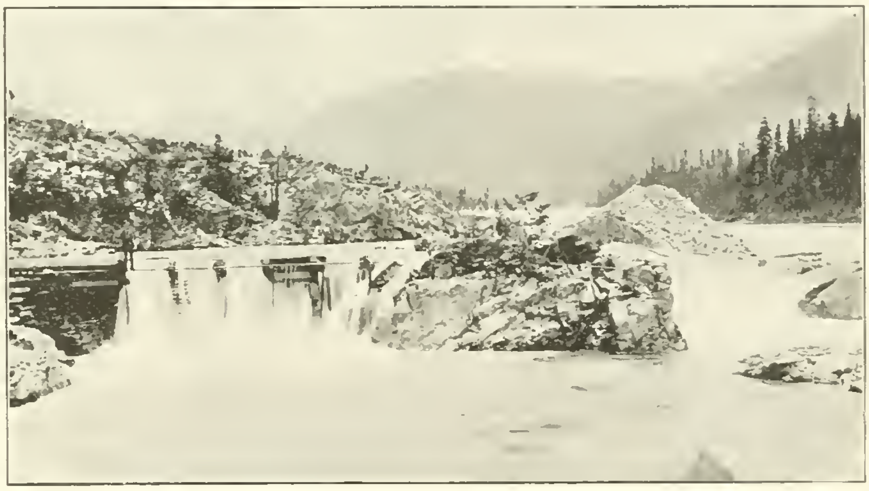


FIG. 2.—WOODEN DAM, SITUATED ABOVE CONCRETE DAM.

The determination to utilize the water power at Bonnington Falls for the development of power led to the organization of the West Kootenay Power and Light Company, which has installed and is now operating the interesting transmission plant about to be described.

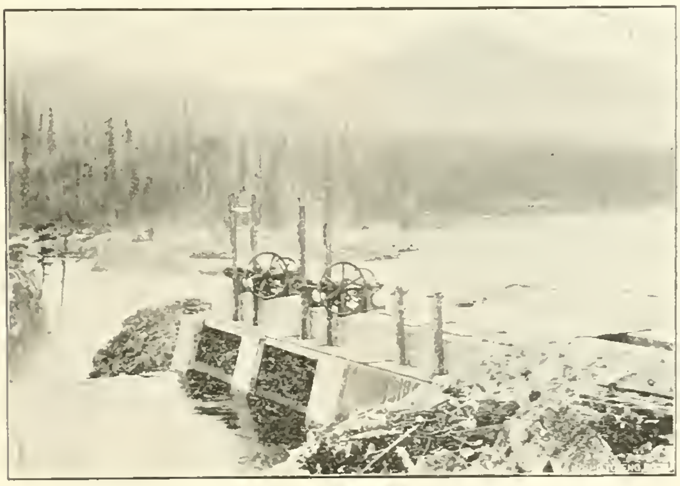


FIG. 1.—CONCRETE DAM, SHOWING HEAD-GATE IRONS.

The conception and commencement of the works are largely due to the efforts of Mr. Oliver Durant and Sir Charles Ross, Bart., the former as president of the company and the latter as director and engineer, in which capacity he devoted considerable time to the careful study of the engineering and financial problems involved.

The charter was obtained in the name of Patrick A. Largey, president of the Centre Star Mining and Smelting Company, Oliver Durant, manager, and C. R. Hosmer, manager C. P. R. Co.'s Telegraphs, and was afterwards transferred to the West Kootenay Power and Light Company.

Primary surveys were made early in 1897, but it was July of that year before the location of the plant was definitely settled and actual construction begun. The plans of the company contemplate the ultimate utilization of the entire three falls, which will give 60,000 h.p., the middle fall now being used developing 20,000 h.p.

POWER HOUSE.

The power house, shown on following page, is located on the west side of the dam. The foundations are built of cut granite; the walls of brick; the roof is of wood covered with galvanized iron; the station is 40 feet long by 60 feet wide, outside measurement, giving accommodation for two 725 k.w. and one 1,200 k.w. units directly coupled to horizontal water wheels. The height of the building from floor to ridge of roof is 40 feet, thus allowing ample room overhead for the handling of the machinery.

HYDRAULIC PLANT.

The dam, as shown in figure 1, extends across the end of the canal for a width of 60 feet. From the south corner of this dam the wing dam extends a distance of 120 feet, this being constructed of concrete, forming one side of the fore bay, which is also shown in figure 1. There is a rack in the fore bay extending the full width of the dam, and the water, after passing through this, enters the penstock, and from the penstock flows to the water wheel casing, which is really a continuation of the penstock flowing from the draught tubes into the tail race underneath the water wheel house.

From the main water wheel casing there is tapped a 26 inch pipe, which conveys the water to a 50 h.p. horizontal wheel, which is used for running the exciter. The head has a maximum of 42 feet and a minimum of 34 feet.

WATER WHEELS.

The main water wheels for this plant were furnished by the Stilwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, and are of their well-known Victor type. There are two pairs of 39 horizontal wheels in each case, which are connected directly to each generator shaft. These wheels are designed and guaranteed to develop 1,180 h.p. per set. In addition to the wheels just described, there are two pairs of 12 inch wheels of the same manufacture used in operating the exciters for furnishing the exciting current to the three phase generators in the station. The governors were also furnished by the Stilwell-Bierce and Smith-Vaile Company, and are of the Geisler type, driven by a belt connected on a small pulley on the water wheel shaft. Each governor operates the gates for each set of two wheels.

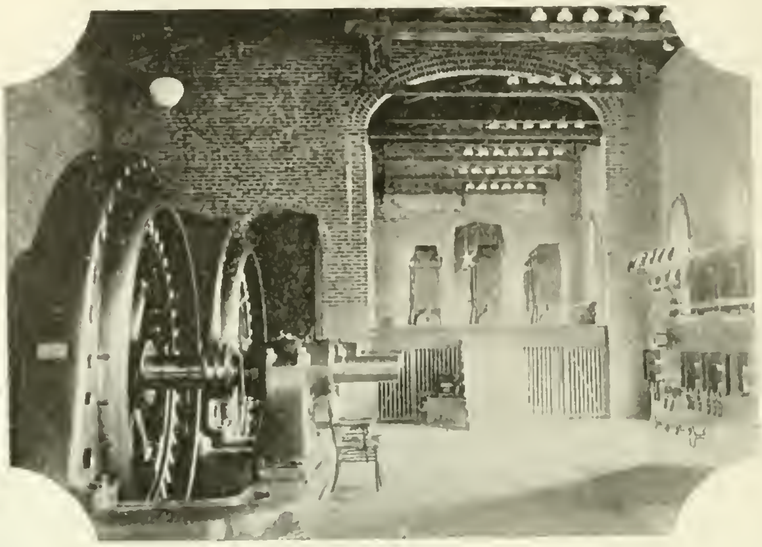


FIG. 4.—INTERIOR OF GENERATING STATION.

ELECTRICAL APPARATUS.

All of the electrical apparatus installed is of the Canadian General Electric Company's manufacture. In the generating station there are at present installed two 725 k.w. three-phase generators of the revolving field type, having 40 poles and operating at a speed of 180 r.p.m., giving frequency of approximately 60. These machines are shown in figure 2. They are of the well-known Canadian General Electric Company's type, with pole pieces built of laminated iron thoroughly insulated from each other by a coating of japan.

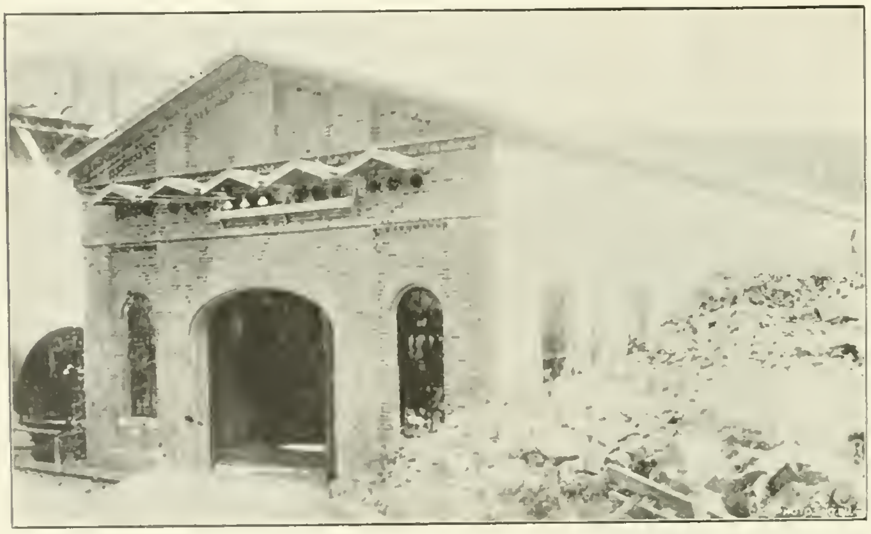


FIG. 3.—POWER HOUSE.

The pole pieces, field coils and armature coils are arranged in such a manner that the windings may easily be removed without disturbing the armature or the magnet yoke. The field windings are wound on bobbins and thoroughly insulated with oiled linen. The armature is of the stationary type and thoroughly ventilated by means of air ducts ¼ inch wide. The armature laminations are dove-tailed into the spider, thereby dispensing with the use of bolts through the core.

The bearings of these machines are of the self-oiling, self-aligning type, and the sleeves of cast iron lined with genuine babbit metal. The base frame of these machines is so constructed that the armature may be moved parallel with the shaft in order that the field and armature may be repaired without tearing down. The approximate weight of the revolving field is 27,000 lbs., the complete weight of each machine being 96,000 lbs. The generators are designated as A T 40-725-180, shunt wound, 1,100 volt generators.

The current is generated under a pressure of 1,100 volts and is conducted from the generator to the machine panels and from the machine panels to the transformer panels; from the transformer panels it is conducted to the primary side of the transformers and stepped up to either 11,620 volts when delta connected, or 20,100 volts when Y connected.

From the high tension side of these transformers the current is conducted to the high tension switches on the transformer panel, passing from there to the line panel, and thence to the line.

The transformers are of the air blast type, of 242 k. w. capacity each. There are at present installed two sets of three, which is ample to take care of the full current output of the generators. As a means of cooling, two 60" Buffalo blowers are used, the air from these being conducted through brick air ducts to the transformers.

Everything in connection with the power house is fire-proof in every respect.

THE POLE LINE.

The pole line is of a very substantial type of construction, being of round timber of specially selected cedar. The poles vary from 30 to 65 ft. in length, according to location. They are set 100 feet apart, or 50 to the mile, all corners and curves being properly guyed. A right of way 100 feet wide has been cleared

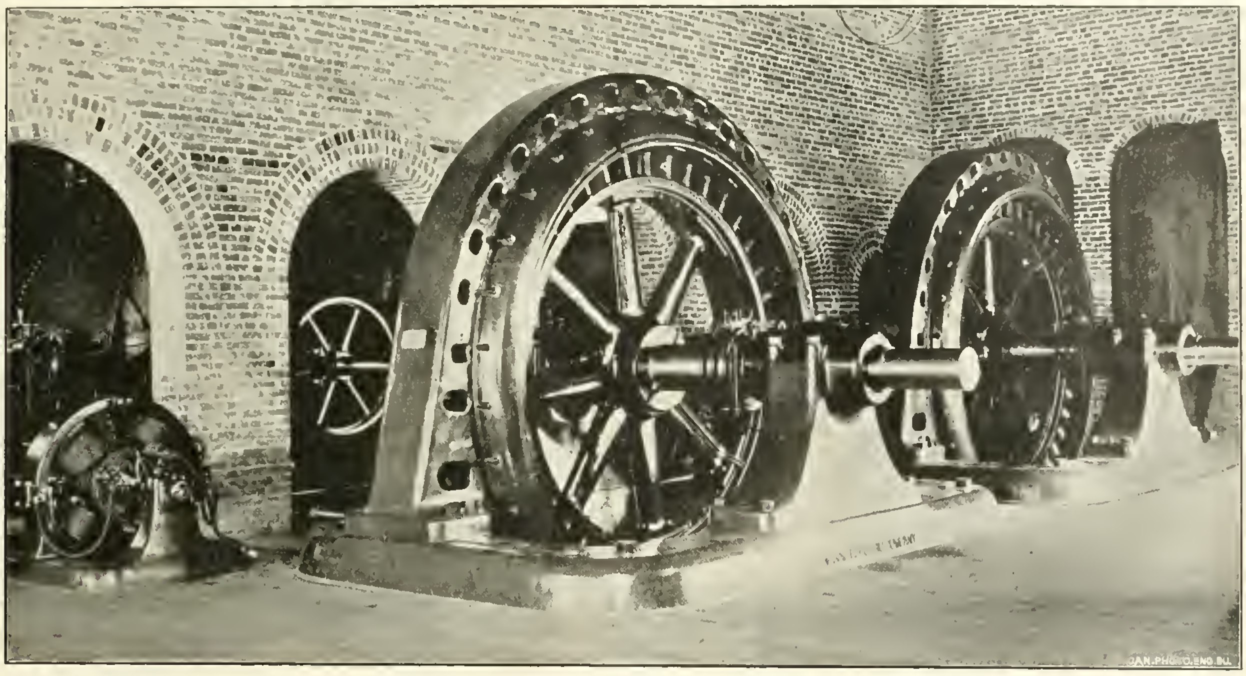
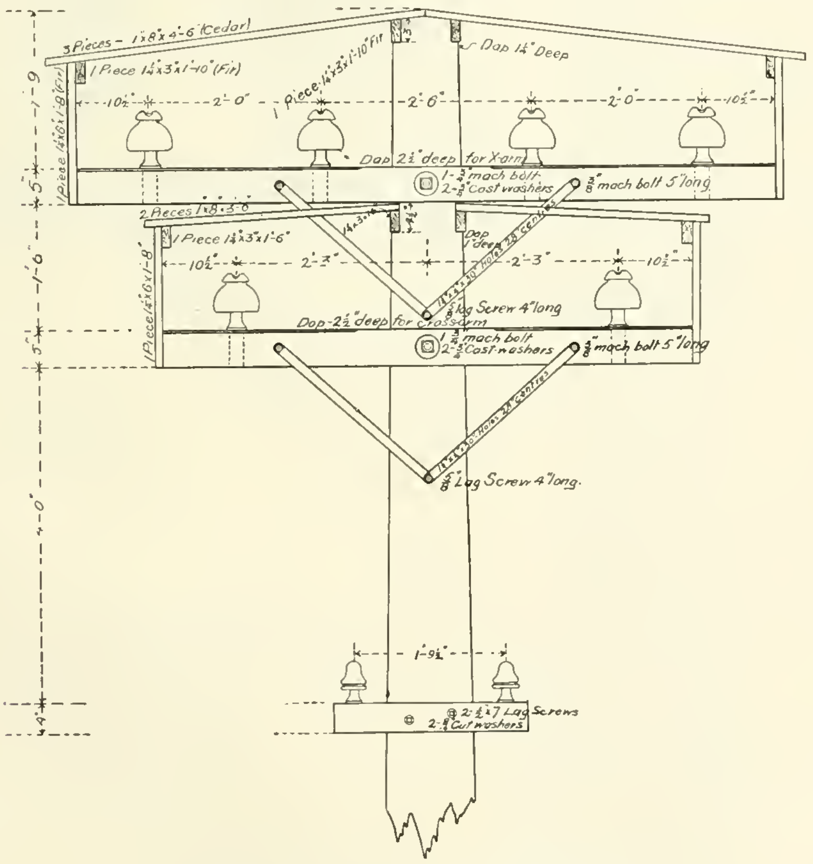


FIG. 5.—VIEW OF GENERATORS AND EXCITER.

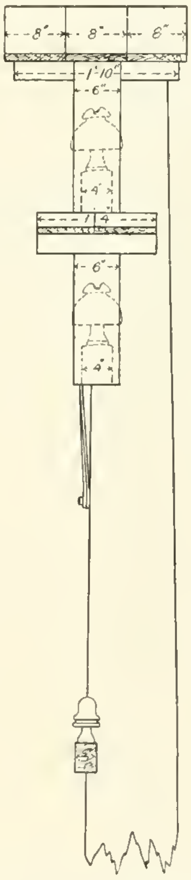
throughout the whole route, which is heavily wooded.

The construction of the pole line embodies all the best features of most improved practices in transmission work, as shown by the accompanying sketch, giving all the dimensions and details of the construction throughout. The reader will observe that the pole line has a housing 24 inches wide on each pole. On account of the many mountains encountered it was impossible to obtain a hanging insulator of sufficient mechanical strength to withstand the strain, and consequently the only way to overcome the difficulties encountered by wet snow was by the use of housing boards, as shown.

From the time winter sets in there is no wind whatever, and as the snow is of a very wet nature it piles up to a height of two feet on a cross arm 4 inches wide, remaining in this position until relieved by a chinook wind, characteristic in the western country. A single three wire, three phase circuit of No. 2 medium hard-drawn copper of Dominion Wire Company's manufacture extends from the power house to the sub-station at Rossland, a distance of 30 miles by the pole line.



DETAILED SKETCH OF HIGH TENSION POLE LINE.'



END VIEW OF POLE LINE.

The following shows the material required for one pole:

Two machine bolts, diam. ¾ in., length 14 in., thread 4 in. long, galvanized; 4 machine bolts, diam. ⅜ in., length 5 in., standard, galvanized; 2 lag screws, diam. ⅝ in., length 4 in.; 2 lag screws, ½ in., length 7 in.; 4 wrought washers, diam. 7/16 in.; 2 wrought washers, diam. 9/16 in.; 4 cast washers, diam. 13/16; 4 cross-arm braces, 1¼ in. × ¼ in. × 30 in., holes 28 in. centres; 6 high potential insulators; 2 S.P.E.L. insulators; 6 locust top pins, shanks 2 in. diam., 5 in. long, standard top; 2 oak top pins, 1½ in. standard; 1 fir cross-arm, 4 in. × 5 in. × 8 ft. 3 in.; 1 fir cross-arm, 4 in. × 5 in. × 6 ft. 3 in.; 1 fir cross-arm, 3 in. × 4 in. × 2 ft. 3½ in.; 6 pieces cedar, 1 in. × 8 in. × 4 ft. 6 in.; 4 pieces cedar, 1 in. × 8 in. × 3 ft.; 4 pieces fir, 1¼ in. × 6 in. × 1 ft. 8 in.; 4 pieces fir, 1¼ in. × 3 in. × 1 ft. 10 in.; 4 pieces fir, 1¼ in. × 3 in. × 1 ft. 6 in.

The telephone line, placed four feet below the lower cross arm, is of No. 12 B. & S. hard-drawn copper, transposed every pole. The insulators used are of the type C and Redlands type, while the pins are locust, boiled in paraffine.

SUB-STATION.

In the sub-station is installed a full complement of transformers, similar to those already described. These are wound for a secondary voltage of 2,200, it being the company's intention to distribute at this voltage, and step down a second time where a lower voltage is required.

In the sub-station there is installed the necessary high tension switchboard apparatus, as well as the 2,200 volt distributing board. On this distributing board is mounted total output ammeters, as well as ammeters and volt meters for the different outgoing circuits.

The switchboards throughout are composed of blue Vermont marble panels of the Canadian General Electric Company's well known interchangeable type.

The plant has now been in successful operation for the past two months, and although very severe lightning and rain storms have been of common occurrence, not the slightest difficulty has presented itself, when operating under a pressure of 22,400 volts. Several lightning discharges have frequently entered the generating and sub-stations, but these discharges were promptly taken care of by the banks of the well-known Wirt lightning arresters installed.

The personnel of the directorate of the West Kootenay Power and Light Company is: C. R. Hosmer, manager C. P. R. Co.'s Telegraphs, Montreal; Frank Paul, Belding, Paul & Co., Montreal; W. M. Doull, Doull & Gibson, Montreal; Sir Charles Ross, Bart., Balnagown, Scotland; Oliver Durant, J. B. McArthur and John M. Smith, Rossland. The entire plant is under the personal management of Mr. L. A. Campbell.

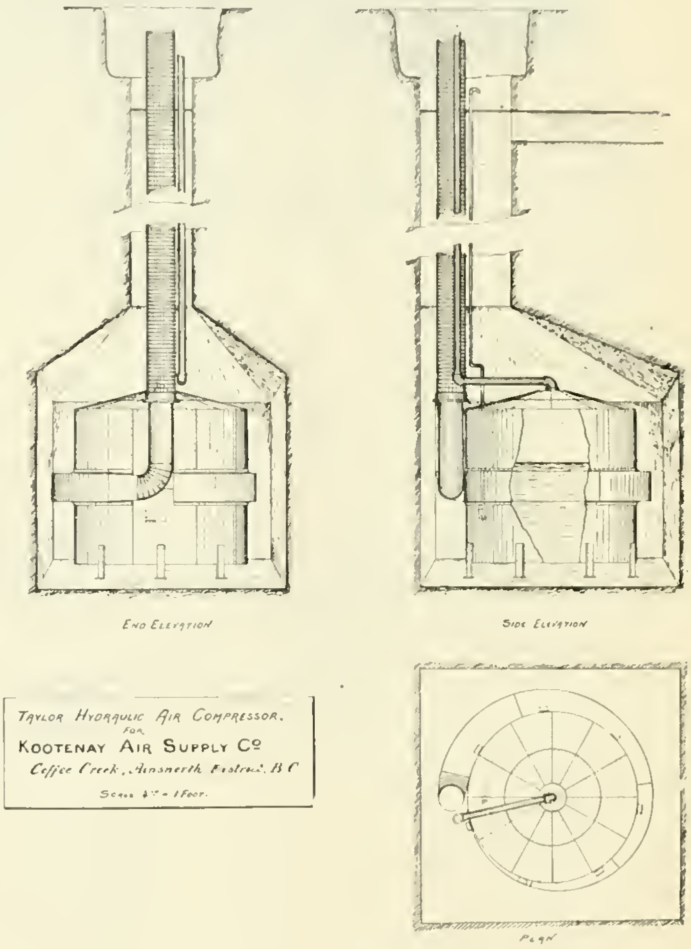
The Canadian General Electric Company have received an order from the corporation of New Westminster for one of their 150 kilowatt monocyclic alternators.

In the colliery districts of Derbyshire and Yorkshire, according to an English exchange, an electrical scheme on a colossal scale has been initiated. It is proposed to supply electricity for lighting, traction and other purposes to a district covering 2,000 square miles, and including the important cities and towns of Sheffield, Rotherham, Lincoln, Gainsborough, Newark, Nottingham, Ilkeston and Worksop. The generating station is to be at Worksop, which is in the midst of a great colliery district, where slack is plentiful at 2s. per ton.

COMPRESSED AIR PLANT AT AINSWORTH, B. C.

As a means of delivering power in long distance transmission, compressed air has lately been brought forward as one of the most economical systems, its advocates claiming advantages therefor over electric power. That our readers may understand the method of operation of a compressed air plant, and be in a position to compare the two systems, we print herewith illustrations and some particulars of the plant installed by the Taylor Hydraulic Air Company at Ainsworth, B. C., for the Kootenay Air Supply Company.

The system of utilizing compressed air is simple, its object being to supply air, uniformly in quantity and degree, by means of falling water. It relies upon the principle that falling water will entrain air and carry it down, producing compression as depth is increased, no moving machinery of any kind being required.



Coffee creek, upon which the works of the Kootenay Air Supply Co. have been constructed, is about two miles from Ainsworth, one of the oldest working mining camps in British Columbia. The creek is a rapid stream, with a flow of from 2,500 cubic feet to 8,000 cubic feet per minute, and a fall at point of utilization of one in ten. A dam, 5 feet high, has been built across the stream, and the water is conducted in a stave barrel flume 5 feet in diameter. The total length of the flume is 1,354 feet, and the pressure on same varies from five to ten pounds, dependent on the height of the stream. This flume, which is constructed with iron rods, cost about $1.25 per foot, exclusive of grading. From the flume the water runs into a receiving tank, which stands on a trestle 110 feet above the surface of the stream at the point where the discharge takes place. From the bottom of the receiving tank, a pipe, 2 feet 9 inches in diameter, descends perpendicularly from the trestle to the ground, and then down a shaft, which is sunk below the level of the creek at the point of discharge, another 105 feet. This shaft is 200 feet in length. It is called the down-flow pipe, and is terminated at the bottom of the shaft by a large bell-shaped tank, which is open at the bottom to allow the water to escape. The water is received through the flume into the upper tank, where it rises approximately to the level of the water in the creek at the point at which it is tapped by the flume.

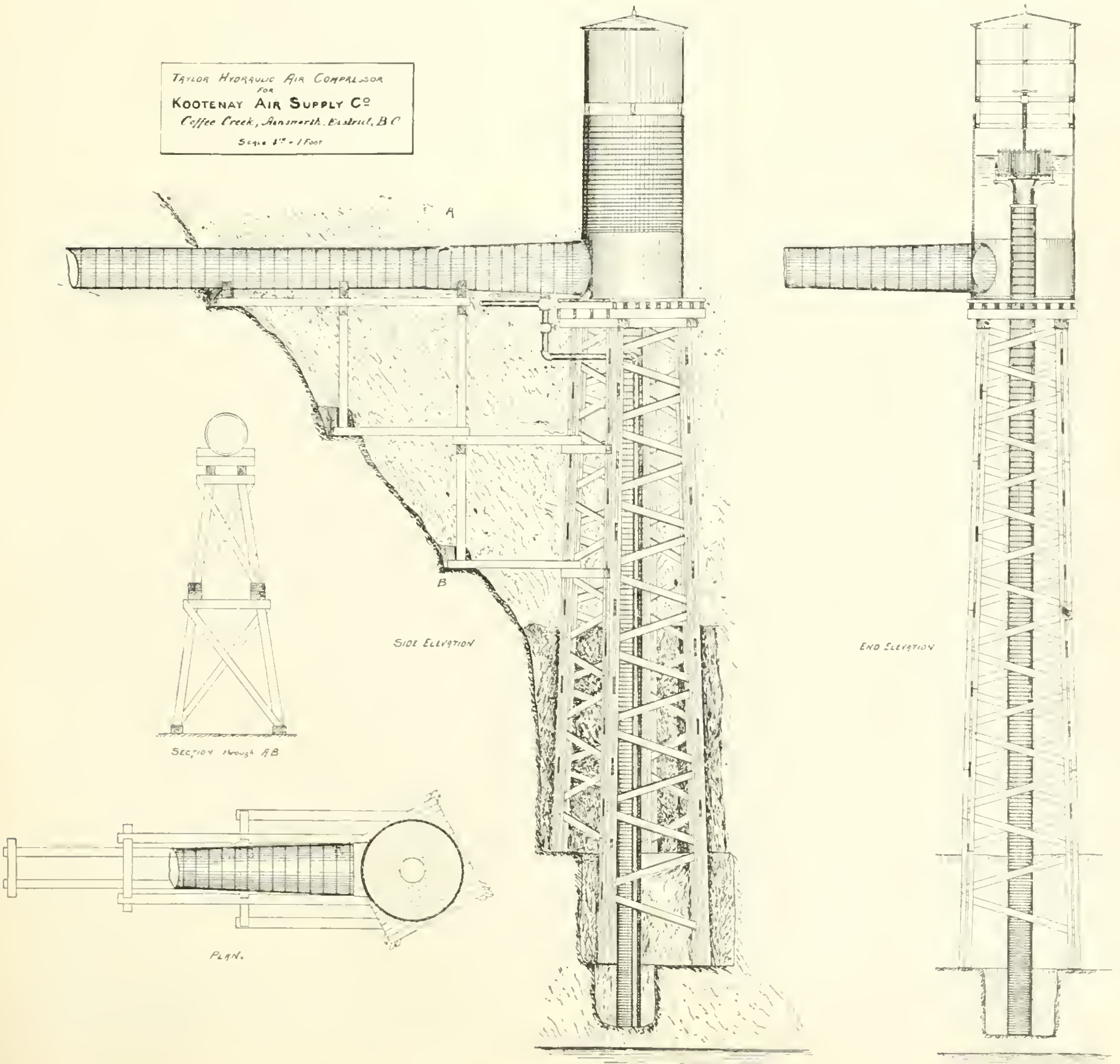
In flowing from the receiving tank to the down-flow pipe, the water passes over the orifices of a number of small tubes, which at their upper end communicate with the atmosphere; hence, the atmospheric pressure drives the air into the water in innumerable small bubbles, which are carried by the water down the flow-pipe into the receiving tank. During their downward course with the water, the bubbles are compressed, the final pressure being proportional to the column of return water sustained in the shaft and tail-race. The head under which this plant will operate is 107 feet from the level of the water in the tank to the level of the water in the creek, and the back pressure of the rising water in the shaft will equalize the pressure in the down-flow pipe, so that the severest pressure at any point on the down-flow pipe will not exceed 60 lbs.

The capacity of the receiving tank in the plant of the Kootenay Air Supply Company is 533 cubic feet. It is 17 feet in diameter and nearly 20 feet high. The down-flow pipe penetrates some seven or eight feet into this tank, there entering a basin contained inside the tank, where the bubbles in the water delivered rise to the surface, and the air and water are separated. The water passes out through the bottom of the tank, rises to the top of the shaft, outside of the down-flow pipe, a height of about 100 feet, and discharges itself again into the creek at a point about 100 feet lower down than that from which it is taken by the flume. The compression of the air contained in the receiving tank may be practically taken as that produced by the weight of water in the shaft outside the down-flow pipe, every 27½ inches of which accounts for a pressure of one pound per square inch.

The main pipe for conducting the compressed air taps the receiving tank at its highest point, and from the main service pipes conveys power for considerable distances for drills and other mining machinery in the vicinity. The plant is said to automatically regulate itself by means of a pipe led upwards until it reaches the level of the water in the tail-race, so that when more air is being compressed than is required, the water in the tube is ejected, and air passes up the pipe until the level of the water in the receiving tank is again higher than the opening of the tube.

The air is being delivered at a pressure of about 90 pounds, and is carried through a nine-inch main for two miles to the centre of distribution. It is claimed that this pipe line will convey between 400 and 500 horse power with a loss of not more than 10 per cent., and that it will discharge 4,600 cub. ft. of free air per minute.

The Kootenay Air Supply Company are said to be selling power for air drills, on the 24-hour run, at $3 per day, and it is estimated that an air drill will consume from 80 to 120 cubic feet of air per minute. The total cost of the plant is given as $30,000.



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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Competition in the Electrical Field. ESTABLISHED and reputable electric lighting and power companies have suffered much injury in the past by the operations of persons who, with little or no knowledge of the business, have proceeded to organize companies and enter fields already thoroughly exploited, slaughtering prices on all sides. There have been instances in Canada where, in towns of two thousand population, a new company has started up in competition with an existing company, the invariable result being disaster to both. In larger towns and cities conditions are to a large extent the same. The imaginary profits which electrical companies are supposed to be making, and a lack of knowledge of the expense and difficulty entailed in the operation of an electric plant, are probably the incentives which induce the promoters of new companies to invest their money in competitive undertakings. They give little consideration to the conditions as they are experienced after the franchise is secured and the plant put into operation. Then they find that the operating expenses are heavy, that maintenance and insurance represent a considerable expenditure, and that owing to variation in the load, characteristic of both lighting and power, a greater capacity in machinery must be installed than would otherwise be found necessary. There are few, if any, electrical plants in Canada paying more than a fair dividend on the capital invested, and until the cost of installation, operation and maintenance is reduced, electric light and power cannot fairly be sold at a price much lower than at present. There are, however, towns and villages in Canada in which electricity has not yet been introduced, and which would seem to offer more promising returns to prospective companies.

Peat Fuel. IN this issue some particulars are given of the steps that have been taken looking to the employment of compressed peat as fuel. The development of this industry has been watched with keen interest, but until recently the success attained was not encouraging to the persons interested. It is said that as early as 1866 air-dried peat was used upon the eastern division of the Grand Trunk Railway, but because of the bulk and uncleanliness of the crude material, its use was discarded. It would now seem that a process has been perfected which overcomes many of the difficulties previously met with, and unless unforeseen obstacles arise, there would seem to be a promising future for the industry. It is indeed gratifying that a Canadian is again to the front with patents, covering not only Canada, but also Great Britain and the United States, for the utilization of what has heretofore been a waste product. The experiments made with compressed fuel under Mr. Dickson's patents have given exceptionally good results, showing the material to be equal to anthracite and greatly superior to slack coal, while it certainly possesses advantages, such as less smoke and ash residuum and practically no offensive gases. Steam users will welcome the advent of any innovation the object of which is to place upon the market, at less cost, a fuel equal to or better in quality than coal. The cost of coal, due in a large measure to high freight charges from the United States, has greatly retarded the development of the natural resources of Canada and checked enterprises which, under more favorable circumstances, would have given employment to a vast number of workmen. With a cheap and satisfactory fuel at our doors, we may reasonably anticipate the greater development of our mines and the establishment of smelting works and other industries which are dependent on cheap fuel. It is yet somewhat premature to attempt to forecast the effect which the discovery of this process of manufacturing compressed peat fuel may have upon the electrical industry, but it would appear as likely to result in the greater employment of steam in competition with water power.

Future of the Storage Battery.

The storage battery is to-day regarded with much less skepticism than a few years ago. As with all innovations and new inventions, practical demonstrations were required to convince an incredulous public that the principles involved were capable of practical application. With the growth of the storage battery industry has come a vast improvement in apparatus, in keeping with the advancement made in other branches of electrical work. Referring to recent developments in the applications of storage batteries, Mr. Joseph Appleton, in a paper read before the Engineers' Club of Philadelphia, points out that the Chicago Edison Company have installed a storage battery plant, the plates of which weigh over one million pounds, being capable of delivering 2,000 horse power for one hour. As showing the connection of the storage battery with the development of water powers for the generation of electricity, he cites the installation of a plant by the Buffalo Street Railway Company, operated in connection with a booster, which compounds it to any desired extent. Other fields in which there would seem to be a future for the storage battery are for furnishing power for car lighting, elevator service, telephone exchanges, and electric vehicles. There are certainly indications that the era of the electric carriage is near at hand, and that the next few years will witness a considerable development along this line in Canada. Proof of this is found in the appearance on the streets of Toronto of an electric delivery waggon, used for a commercial purpose only, and driven by two motors controlled by storage batteries.

The Kootenay Power Plant.

The electrical development of the water power of the Kootenay river at Bonnington Falls, in British Columbia, and the successful inauguration of the plant, marks another step in the advancement of the electrical industry in Canada. This plant has been in operation for a sufficient time to demonstrate its thorough practicability, the machinery having moved with perfect smoothness from the beginning. While in general design the plant of the West Kootenay Power and Light Company does not differ from others installed in Canada, as for instance, one at Goldstream, in the same province, yet there are certain features in connection with its construction and operation that are quite unique and interesting. From an engineering standpoint the most characteristic feature is the method employed for the protection of the pole line from the climatic conditions peculiar to British Columbia. As is well known, the snow is of a wet, sticky nature, which, with the absence of wind, necessitates the construction of housing boards over each pole to protect the insulators and prevent short-circuiting. Two points in connection with the operation of the plant represent comparatively recent developments in the science of electricity in Canada. One is the high voltage employed, and the other the distance to which the current is transmitted. The use of such a high voltage as 22,000 is now considered quite feasible, owing to improved methods of insulation and the perfecting of safety devices, while the lessening of the loss in the line has rendered it practicable to transmit the current a distance of thirty miles, which is the length of the transmission of the plant in question. Almost simultaneously with the starting up of this plant, the machinery of the Cataract Power Company, of Hamilton, was also set in motion, the current being generated under a pressure of 22,500 volts and carried to a transformer station thirty-five miles distant, for distribution. These two plants, it is believed, will prove to be only forerunners of many other similar installations in Canada, some of which are expected to take definite shape at an early date.

ELECTRICAL EXHIBIT AT TORONTO EXHIBITION.

Only four electrical companies are this year represented in the machinery building at the Toronto Industrial Exhibition. Entering the building from the east we find the Royal Electric Company, of Montreal and Toronto, occupying their usual space, with a creditable exhibit under the superintendence of Mr. A. E. Payne, of the sales and engineering staff of the company. In their space proper, about 50 by 40 feet, they show one 75 k.w. S.K.C. dynamo, twenty 60 k.w. and one 40 k.w. dynamos, a full line of direct current motors and S.K.C. alternating current motors, together with transformers, street car motors and controllers, alternating current arc lamps, incandescent lamps, lightning arresters and switches, and a line of beautiful ammeters and voltmeters, made entirely of porcelain and glass, which are attracting much attention. There is also a fine marble switchboard, fitted up with all necessary instruments, including the latest novelty in the way of high tension switches, being a sliding contact switch, which is regarded as a vast improvement over the former style. A pyramid of rubber covered wire of different sizes is also exhibited in this space. In another part of the building the Royal Electric Company have in operation one type B 60 k.w. S.K C. dynamo furnishing current for their exhibit, and two 50 light T. H. arc machines, supplying current to 100 arc lamps of 2,000 c.p. on the grounds and in the buildings.

The W. A. Johnson Electric Company are located in the same space as last year and have an attractive display, the feature of which is a 45 k.w. inductor alternator which the company have lately placed on the market. It has a steel frame, a new style of base, and a two coil field, giving perfect magnetic symmetry and inherent regulation. It has no commutator or collector rings, and there is an entire absence of heating. Two other machines are also in operation, furnishing current to incandescent and arc lamps and for power purposes. Transformers, motors, switchboard apparatus, electric fan, etc., complete the exhibit.

The Electrical Construction Company, of London, Ont., have on view their latest type of multipolar dynamos and motors. These they claim are second to none, their dynamos being especially adapted for direct current isolated lighting, and showing an efficiency in actual work of 90 per cent. Pipolar types are also exhibited, as well as a complete line of electrical supplies.

Motors, dynamos, telephones, switchboard and instruments, lamps and electric fans comprise the chief features of the display of the Jones & Moore Electric Company, of Toronto, who are gradually working their way upward in the electrical field.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NINTH ANNUAL CONVENTION.

Upwards of fifty delegates were present at the ninth annual convention of the Canadian Association of Stationary Engineers, which opened in the Oddfellows' Hall, John street north, Hamilton, on Monday, August 8th last, at 11 o'clock a.m. Mayor Colquhoun, on behalf of the City Council, delivered an address of welcome to the engineers, expressing the hope that a successful meeting would follow. Aldermen Carscallen and Nelligan also spoke, endorsing the sentiments of the Mayor. The latter gentlemen, after reading the Association's preamble, advised careful consideration on the part of the engineers in their legislation. On behalf of Hamilton branch No. 2, the President, Mr. Robert Mackie, extended a hearty welcome to the delegates. The above felicitations were acknowledged by Mr. E. J. Phillip, Executive President, of Toronto, who appointed a committee, consisting of Messrs. Jas. Ryan, A. M. Wickens and W. G. Blackgrove, to draft a reply of thanks. This committee prepared the following response, which was afterwards forwarded to the Mayor :

"We, as a body of engineers, extend to you our hearty appreciation of your cordial and kindly address of welcome to your pleasant and prosperous city at our ninth annual convention.

"We, as a body of workingmen, do not believe in the furtherance of strikes or labor troubles of any kind. We are organized for educational purposes, in order that our employers may be benefitted thereby, and thus ensure for them efficiency, carefulness and stability to reduce operating expenses generally. It is our aim to advance the interest of those by whom we are employed. It may be interesting for you to know that there are members of this association who are worth 100 per cent. more to their employers to-day than they were ten years ago, thus showing that their admission to the society was to their benefit as well as to that of their employer.

"It is not our intention to laud our society as being the best on earth in regard to benefits, such as insurance, sick benefits, etc., but we do maintain that our society is the best organized for the advancement of its members in their calling.

"We are pleased to meet in your beautiful city, and trust that our meeting here may be beneficial to you and the manufacturer and steam user, as well as to ourselves, and hope that we may meet here again some time in the future.

"We wish to thank you for the hearty reception you have accorded us, and we assure you that we feel entirely at home here. We shall endeavor to conduct our business in the best manner possible, and trust our deliberations may be profitable to one and all.

THOS. RYAN, Montreal.
A. M. WICKENS, Toronto.
W. G. BLACKGROVE, Toronto."

PRESIDENT'S ADDRESS.

The President, Mr. E. J. Phillip, then read his annual address as follows :

I have the honor and pleasure to welcome you to this, the 9th annual convention of the C.A.S.E. The subordinate associations have chosen you to represent them at this convention, and to look after their individual interest in particular and the whole society in general. The second meeting of the executive—it was really the first, the previous one being only a meeting to get into shape—was held in this city, and I little dreamed at that time that I would occupy the president's chair at the next meeting in Hamilton ; therefore, it is with pleasure that I greet you, the new members and the jolly good fellows I have met before.

While this meeting should be a criterion by which we can judge the growth of the association, we must not forget the conditions under which the C.A.S.E. is carried on. First, it is not a labor organization, nor is it an insurance society, and it cannot be called a secret or benefit society, nor is it a political or religious order; it is purely an educational institution. Therefore the growth of the order is limited for several reasons. We have not the attraction that insurance, secret, benefit or labor organizations have. The field from which we draw our members is limited and scattered, and there are few places where there are plants enough to get a number of engineers to join an association ; another reason is the fact that as boys at school hate to be taught, so we grow up, and it is hard to get a man to realize that he has much to learn, and as education is the only object for joining the association, some object to letting the public know that there is anything yet for them to learn. Now, while the growth of the order is apparently small, at the same time the percentage of good done its members is much greater than any other order that I know of, as many can testify to. We meet again here this year to try and work out other ideas for the benefit of the order and each member individually.

I hope you will all give your attention to the business that will come before you, that our meeting here may result in profit to ourselves and prosperity to the society. The prospects for the coming years are brighter than for years past ; times are good in this country, and when the war is settled the big country to the south of us will brighten up and their prosperity will add to ours. So that if we have grown in the past few years we will boom in the next. Hard times have had their effect on this order like all others, but hard times are a thing of the past in this country, and will be for some time to come, if I am any prophet, and if those who have been the stay of the association in the past will keep on pushing they will reap the harvest they have been looking for.

Better work has been done in the subordinate associations during the past year, in the line of reading papers and making the meetings entertaining and instructive, than other years ; and it is noticeable the improvements in lodges where this matter is thoroughly carried out. I am pleased to state that Hamilton No. 2 is carrying this work out to perfection. There was one new association formed during the year in Toronto. It is a good live association and will materially help the order in Toronto and vicinity. The matter of a hand-book taken up last year was completed this. The secretary will no doubt make you a full report on the matter.' I have not had the time to give to executive business that I would like, from the fact that this has been the busiest year with me that I ever experienced, in fact, it was very difficult to get away to attend this convention ; in consequence of this the work has all devolved on the secretary, and, as in past years, the secretary is by far the most important officer of the executive. So much so that it has been suggested that a permanent secretary be appointed, or at least have the secretary hold office for more than one year. As it is now, it takes a man the entire year to get accustomed to the work, and then he is changed, making confusion and loss of time to both executive and subordinate lodges that would be avoided by a permanent secretary. In conclusion, brethren, I hope you will give me the support that you have given the chair in the past, and that you will attend strictly to business while there is business to be done. I wish it were in my power to do all for the C.A.S.E. that I would like, and place it at the head of all societies, where it belongs, because it is founded on education.

After the reading of the above address, the minutes of the last annual meeting, held at Brockville, were read and confirmed. The following committees were appointed :

Credential Committee George Mackie, Peter McNaughton, George C. Mooring.

Audit Committee— W. J. Webb, Peter McNaughton, Wm. Bear.

Constitution Committee—Thomas Ryan, G. C. Mooring, Wm. Allen, Thos. Pilgrim, George Mackie.

Good of Order Committee J. M. Dixon, W. F. Chapman, Thomas Eversfield. G. C. Mooring, J. J. Richardson.

Mileage Committee R. C. Pettigrew, Joseph Robinson, John Fox.

Notice was given by a Toronto delegate that he would move that several minor changes be made in the constitution of the Association, after which the meeting adjourned until 10 a.m. the following day.

SECOND DAY.

After the roll call, Mr. J. G. Roberson, Secretary, of Montreal, read his annual report, which stated that during the year two associations, viz., Stratford and Wiarton, had been reorganized, and were now in a prosperous condition. The Treasurer reported that the total receipts for the year were $559.99, and the balance now in the treasury $290.04. No returns could be made regarding the hand-book issued by the Association until next year. It was likely to prove a financial success. Some discussion arose regarding the proposition to reduce the per capita tax from 70 cents to 50 cents a member, which was defeated. The above reports, as well as that of the auditor, were adopted.

A discussion followed on several proposed alterations to the by-laws. The proposal to do away with the offices of door-keeper and conductor was defeated, as was also the amendment to article X, which recommended that the executive officers do the work of the district deputy. It was decided to allow past-presidents the privileges of the convention, but that they should receive nothing for expenses. The Educational Committee presented its report.

On motion of Mr. J. M. Dixon, seconded by Mr. W. F. Chapman, it was resolved that the Executive Secretary should be appointed for two years instead of one. A proposition that the convention be held bi-ennially instead of annually in future was defeated. Mr. J. D. Taylor, of the International Correspondence School of Scranton, Pa., addressed the meeting, after which a resolution was passed recommending the school to all stationary engineers.

In the afternoon the visitors enjoyed a sail on the steamer "Acacia," and in the evening, at 8 o'clock, again assembled for business. Mr. E. G. Barrow, city engineer of Hamilton, presented a paper on "Sewage Disposal Works." Mr. Barrow briefly described the various methods of purification, and gave some interesting particulars of the sewage disposal works recently completed for the city of Hamilton under his supervision. A paper on "Oils in the Engine Room" was read by Mr. J. S. Williams, chemist. This paper was to a large extent a reconstruction, with some additional data, of a paper read before the Hamilton Association last spring, and which has already appeared in this journal. An interesting discussion followed relative to the various classes of oils, and their special uses. The following paper was read by Mr. P. McNaughton, of Montreal :

EVAPORATION AND THE RAISING OF STEAM IN BOILERS.

By P. MacNaughton.

From the title of this paper you will notice that it is to deal with two things : First, evaporation, and second, the making of steam in boilers. These two actions are often considered as if they were distinctly different, but I think it can be shown that the actions are the same in the end, and that they differ only in the way in which the end is reached. In the following remarks it will be noticed that I have tried to show how the natural action of evaporation resembles the action of making steam for power, because it is always instructive to think out how the processes which we make use of every day compare with corresponding ones in nature. Some have said that it is wasting time thinking of things in this way ; if they really think so it would be wasted time ; but to others it would be very instructive and pleasurable. I might say that such thoughts would be to them as salt, which, though of little use in itself as a food, still makes our food more palatable. Strictly speaking, the term evaporation is used to denote nature's method of changing water into vapor, and making steam in boilers is part of man's method of changing water into vapor, through an intermediate state familiar to all of us called steam.

The principal actions in nature in which evaporation plays a part have been noticed by all of us ; they are the dissappearing of the dew from the grass on a summer morning, and the frost later in the season, the dissappearing of water when left standing in open vessels, and on a much larger scale the raising of water from our rivers, lakes and surrounding ocean. Now, it is usually admitted that for every action there is a cause, and the cause of evaporation in nature is the heat of the sun. It will make our problem much simpler if we consider, for instance, a bucket of water as made up of a great number of particles of water. That this is the real state of water will be seen at once if we remember that when heat is applied to water it forms steam, which is particles of water visible to the eye, and if heat be applied to steam the particles of steam are divided into smaller particles called vapor, which is invisible.

Atmospheric air, among other things, contains a certain amount of water vapor, and this water vapor as long as the sun is shining, is kept suspended uniformly through the atmosphere by the sun's heat. When the sun has set and its heat no longer acts on the atmosphere, this water vapor tends to condense to a slight extent, and with this condensation it becomes slightly heavier than the other components of the air, and so tends to sink towards the earth, so that in a calm, clear night in summer that part of the atmosphere lying next the earth contains more moisture than that which is higher up.

That the above statement points out the true state of the atmosphere at night is proven by noticing the land fogs. If we go up a mountain at the first of daylight on a calm, foggy morning, we will notice that as we ascend the fog becomes less dense until, when we have gone up about four or six hundred feet, we will be out of the fog altogether.

This layer of moist air coming in contact with the cool leaves of trees, plants or other vegetation, the water vapor which it contains is further condensed, thus forming dew. I wish it to be clearly understood at this point that the collecting of dew on the leaves of plants is owing to condensation and not to a falling of water as rain. The fact that dew only gathers on the top side of the leaf and does not collect in our houses even if all the doors and windows are open is owing to another action which has no bearing on the subject in hand.

Now we come to evaporation or the dissappearing of the dew. We have the air in two layers, the moist one lying near the earth and the dry one higher up. The sun rising in the sky begins to send its rays of heat earth-ward, the layer of air lying next the earth becomes warmed first, and owing to the principle that warm air rises, it rises and the cooler air comes down to take its place next the earth. The air which is now next the earth is dry or lacking in water vapor, so the lack is made up by absorbing a certain amount of water in a state of vapor from the dew on the plants. This circulation has not continued long before all the dew is evaporated. This process of evaporation in nature does not cease when the dew has disappeared, but goes on continually, because there is always a demand for more water vapor in the air on account of it being partially condensed in the upper regions of the air, thus forming first clouds, and if condensed further the clouds form rain or snow.

We will now proceed to discuss the making of steam in boilers, and then its change from steam to water vapor, after which we will compare it with the process described above. For purposes of comparison we will turn water into steam in a boiler open to the atmosphere, that is to say, we will raise steam under a pressure of 14.7 lbs. per square inch. In this we are under the same conditions as the dew which was turned into vapor under atmospheric pressure also. We will suppose that the boiler which we are going to use is a small, circular vessel say 6" in diameter and 12" deep, which may be set over a stove hole and supplied with a steam tight cover somewhat like a piston, by using which we may vary the pressure. We will now put some water in the boiler, and place it over the fire, the cover being left off. Now, remembering that water is made up of particles held together by a force (in this case 14.7 lbs. per square inch, or whatever the barometer may read), which must be overcome before we can have steam, we are called upon to exert a force in opposition to the force holding the particles together. We do this by lighting a fire under the boiler. As the fire burns, a certain amount of the energy of the coal is transferred to the water, causing its temperature to rise until when it has reached about 212 F. the coal has transferred enough of its energy to the water to enable it to overcome the atmospheric pressure ; and water pressure and steam is given off. Now we have water in a state of steam which is visible to the eye. If we watch the cloud of steam as it rises upward it will be noticed that it gradually gets thinner and thinner until at last it disappears from view.

What has become of it ? We have produced the invisible water vapor and it has been absorbed by the air.

The change from steam to vapor took place like this : In a boiler it is the water which lies next the surface exposed to the fire that is first turned into steam. In order to do this the coal must transfer enough energy to the water to raise not only the atmospheric pressure, but also the pressure due to the depth of water in the boiler. Now, when the particles of steam emerge from the surface of the water they are under a less pressure than when at bottom of the boiler, and so contain more heat than is necessary to keep them as steam. This surplus heat or energy causes an expansion or bursting of steam into the smaller particles which constitute water vapor, which is absorbed by the atmosphere. This last expansion is on the same principle as when we open a try cock below the water line on a working boiler it is not water that blows out, but steam or vapor.

We will now sum up these two operations. In the first, the heat or energy of the sun does work on the atmosphere, thus setting the air in circulation, and as a result of the air circulating water is absorbed. In the second, the heat or energy of the coal does work on the atmosphere, setting free the steam and at the same time storing in the particles of steam an energy which turns the steam into vapor when it rises into the air.

From the above conclusions we see that evaporation, or nature's method of making water vapor, and the making of steam at atmospheric pressure and its change into vapor, differ only in the two forces that produce them.

In reference to making steam in boilers there are two interesting cases besides the one which we have just discussed, namely, making steam under a pressure greater than the atmospheric pressure, and under a pressure less than the atmospheric pressure. Dealing with the first mentioned case, that is, where the pressure is greater than the atmospheric pressure : This condition can be brought about by fitting the steam tight cover on the boiler mentioned in the first case and putting some weights on it to the amount of 5 lbs. per square inch. Now, instead of steam being given off when the water is at about 212° F., it will not be given off before the temperature is 226 F. This increase in temperature is due to the fact that before steam can form in this case the coal must transmit to the water enough of its energy to raise 19.7 lbs. per square inch, instead of 14.7, as before. This condition of things comes about naturally when boiling water in mines, for as as we descend into the earth the atmospheric pressure increases, which corresponds to the added weights.

Lastly and briefly, we will consider the making of steam under a pressure less than the atmosphere at sea level. For this we would have to exhaust the air from our boiler by an air pump or other means. Then we would find that steam would be given off when the water is at a temperature less than 212° F. according to the amount by which the pressure in the boiler is less than atmospheric pressure. This shows that as there is less pressure keeping the parts together in this case than in the other two it therefore requires less energy to set the steam free. As an example of this in nature, it has been noticed by travellers going up mountains that when they get high up it takes a much longer time to boil eggs than on the plain below, although the water in giving off steam went through the same action in both places. This was due to the fact that at the top of the mountain the pressure of the atmosphere was less than at the bottom, and the water though giving off steam did not contain the heat necessary to boil the eggs. I think if these travellers had been engineers they would have piled some stones on the lid of their kettle in order to save time. In this case it is interesting to notice that although it requires less heat to raise steam at a high elevation than at the ordinary atmospheric pressure at the sea level, we do not gain anything by reducing the pressure, because when we sum up the heat required to raise the steam and the force required to reduce the pressure below the atmosphere we will find that it will amount to the same thing as if we were making steam at atmospheric pressure.

The above paper was greatly appreciated by the engineers, as was also a paper by Mr. Charles Moseley, chief engineer of the Toronto Incandescent Light Company, which is also printed herewith :

ECONOMY IN THE BOILER ROOM.

By Chas. Moseley.

The fuel expense is one of the largest in the operation of the majority of plants, and any reduction which can be made in the amount of fuel used, while maintaining the same amount of power, is considered a direct gain. The evaporation of more than nine pounds of water per pound of coal is looked upon with suspicion by many, as it is thought impossible to obtain more than this amount in even the best designed and well regulated furnaces and boilers, especially when the firing is done by hand. Mechanically fed boiler furnaces usually give the most economical results. The actual value of the fuel depends upon the way in which it is used fully as much as on any other factor. The heat unit in the coal should be as much as possible utilized. In one pound of good steam coal there is about 14,000 B.T.U., and about 10,000 of this amount can be utilized, so that 4,000 heat units are lost.

The mixture of gases in a furnace depends on the amount of air used. One pound of coal requires, theoretically, about twelve pounds of air to burn completely, but in practice about twice this amount is required in the boiler furnace. To cause good combustion, coal requires a good draft ; the gases are consumed near the fire and the waste gases carry the heat to the boiler on their way to the stack. The boiler ought to have sufficient heating surface, or the hot wasted gases ought to travel a sufficient distance to be cooled down to about 350° F., which temperature is found high enough to produce a good draft in a stack at least 100 feet high. It is not necessary for me to state the need of keeping the combustion chambers free from the ash that is carried over with the gases to the chambers.

In "Smokeless Heat," published by the General Engineering Company, there is a paragraph entitled, "Competitive vs. Ordinary Test," which is well worth consideration, and I think we might study it with profit. In nearly all plants where a large quantity of coal is burned per day, it is a general rule to employ the least possible number of firemen, and it keeps them very busy going from one boiler to another shovelling coal in the whole time. It becomes more of the nature of slavery than anything else. Is there economy in this way of working? Let us see.

In making evaporation tests my experience has been that there is a large difference between ordinary working and working for short spells, as in making competitive tests. When we were making tests in our plant while experimenting with shaking grates, the Hawley Down Draft and the Jones Underfeed, we did so in many different ways. With the Hawley Down Draft in one particular case we fired the boiler as we would in ordinary practice, and the result was certainly a far different one from that obtained when the man stood by the furnace and attended to it alone. If we treat the fireman as being naturally lazy, I think we will be on the safe side, and you can rest assured that if he has one boiler that will do the same work as another with half the labor, even though the other takes less coal, this boiler will get the most work, and the boiler that should receive constant attention will get very little consideration from him. Between competitive and ordinary working on a hand fired boiler there is actually a difference of 10 per cent. This I have proved repeatedly, and in many cases it has run up as high as 12 per cent. What does this mean? Does it mean that it would pay to have a man at each boiler and simply attend to it alone? No, it does not, for the simple reason that the less a man has to do, the less he is inclined to do, and this applies more to firemen than to anyone else.

I might state that when we were testing the Jones stoker we had long periods when we had competitive tests, and others again when we ran as in ordinary practice, that is to say, the fireman doing just precisely as he would do if no test was being made. The coal and water, however, were measured in each case. The results were simply astonishing. In the ordinary running test the Jones stoker would do about 50 per cent. more work and nearly 25 per cent. better economy, whereas in the competitive test the work done on the stoker was about 25 per cent. more and 15 per cent. increased economy, which bears out the statement that between competitive and ordinary running we have a difference of 10 per cent. Now, which is the correct way to look at this matter? Can we obtain results right along with hand firing equivalent to those obtained during a competitive test. I do not think so, because firemen as a rule do not like to be beaten, and will do their very best during a competitive test to do up the other fellow, but at the same time he is wishing inwardly that the test was over, so as to get back to the old style again.

There are many plants in Canada where very good results are obtained, if we take the results as shown by engineers into consideration, several of them showing a usual 14 lbs. evaporation per pound of coal. This, you will readily understand, is out of the question. There are also a large number where very poor results are obtained, and these poor results are due to several causes, namely : Boilers in very bad order, dirty tubes, poor setting, poor boilers, poor firemen, etc. The men who sell boiler compounds will in all probability say that you do not use enough of their compounds. Your answer to that is, of course, that there are compounds on the market that are absolutely of no use whatever, and it is simply throwing money away to buy it. I myself believe in a good compound, but will admit that it is difficult to get it. You may get one barrel (the first from a new maker) fairly good, the second of no use whatever, and so it goes. A good compound is required, and to my mind to-day we have not such a thing. All compound makers ask you in their advertisements to send on a sample of your water and they will give you the very compound you require after analysis. You, of course, know what this means—that if one brand does not work they will send another brand, of practically the same material, with another name, and you try it.

Poor boilers and poor setting : This is attributed to trying to keep down the first cost. Pay a good figure for a good boiler, and have it set by competent men.

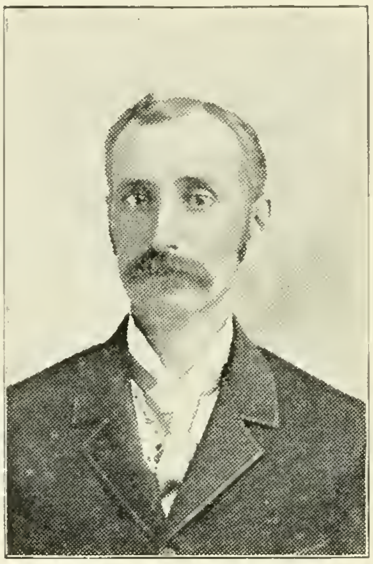
Poor firemen : This, in my humble judgment is the most important item, and one that should receive much consideration. The fireman may not be poor, but the work he has to attend to—namely, firing too many boilers—makes him feel that he is nothing more or less than a laborer, and as long as he keeps the steam pressure up, no matter how much coal he burns or how he does it, there appears to be little or no attention paid to him. There are many places where the fireman is never thought of except when the steam pressure goes down, and when such is the case the usual deputation calls upon him to ascertain if he is asleep or not. A good fireman is really a skilled workman, and should be treated as such. He should receive a fair salary, and his employer should bear in mind that any reduction in his pay is far from being a saving. If he is cut down $2 per week, you will in all probability find your coal bill increased about $8, and there is not much economy there.

How are we to obtain better results in our boiler rooms? I think by putting in machines to do the work, and having men simply to look after them.

THIRD DAY.

Upon reassembling on Wednesday morning, the report of the Mileage Committee was presented and adopted. This fixed the total expense of travelling, etc., at $179.

Mr. W. F. Chapman reported on behalf of the committee appointed to interview the members of the Dominion government with a view of having a Stationary Engineers' License Bill passed. The Minister of Justice had stated that it was out of the jurisdiction of the Dominion government, and would have to be taken before the Provincial legislature. A new committee, consisting of Messrs. Dixon, Allan, Webb, McNaughton and Pettigrew, was appointed to take such further steps as might be deemed advisable. It was felt that a bill somewhat analagous to the Marine Engineers' bill would be satisfactory.



Mr. W. F. Chapman,
President Canadian Association Stationary Engineers.

The Committee on the Good of the Order presented its report. It recommended that more consideration be given to educational matters.

A committee, consisting of Messrs. Ryan, Robertson and Dixon, was appointed to arrange for the publication of the Association Bulletin and reports.

In the afternoon the election of officers was proceeded with, the result being as follows : W. F. Chapman, Brockville, president ; R. C. Pettigrew, Hamilton, vice-president ; J. G. Robertson, Montreal, secretary ; G. C. Mooring, Toronto, treasurer ; William Bear, Dresden, conductor ; John Wendell, Waterloo, doorkeeper.

It was decided to change the name of Toronto Branch No. 2 to No. 18, as the Hamilton Branch is known as No. 2. Berlin was selected as the meeting place for the next convention. Past-presidents' jewels were presented to Messrs. E. J. Phillip, of Toronto, and Thomas Ryan, of Montreal.

Through the courtesy of the Hamilton Street Railway Company, the delegates enjoyed a trip around the city in special cars. Invitations were accepted to visit the Museum and the Gurney-Tilden Company's works.

THE BANQUET.

On Wednesday evening the usual dinner, tendered by the local association, took place at the Waldorf Hotel. The president's chair was occupied by Mr.

Robert Mackie, and the vice-chair by Mr. Thomas Chubb. Toasts were responded to by the following: "Canada, Our Home," by Stuart Livingston; "Mayor and Corporation," by Ald. Nelligan and ex-Mayor Blaicher; "Manufacturers," by ex-Ald. A. H. McKeown; "Educational Interests," by Inspector Ballard, J. S. Williams and Percy Domville; "The Executive Head," by president W. F. Chapman, ex-president E. J. Philip, and Joseph Robinson; "Sister Associations," by A. M. Wickens and John Field; "Press," by E. B. Biggar. Songs were contributed by Messrs. James Jardine, George Allan, E. T. Martin, W. W. Barlow and W. G. Grant. The committee in charge of the banquet arrangements consisted of Messrs. Robert Mackie, chairman; J. Ironsides, secretary; W. R. Cornish, W. Stevens, R. E. Chilman, Thomas Chubb and George Mackie. It was conceded by all that the banquet was a complete success in every respect.

MR. R. C. PETTIGREW,
Vice-President Canadian Association Stationary Engineers.

MOONLIGHT SCHEDULE FOR OCTOBER.

Day of Month	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	No Light.	No Light.	.....
2....	P.M. 6.00	P.M. 8.30	2.30
3....	″ 6.00	″ 8.30	2.30
4....	″ 6.00	″ 9.20	3.20
5....	″ 6.00	″ 10.00	4.00
6....	″ 6.00	″ 11.00	5.00
7....	″ 6.00	″ 11.50	5.50
8....	″ 6.00	A.M. 12.50	6.50
9....	″ 6.00	″ 2.00	8.00
10....	″ 6.00	″ 3.00	9.00
11....	″ 6.00	″ 4.10	10.10
12....	″ 6.00	″ 5.10	11.10
13....	″ 6.00	″ 5.10	11.10
14....	″ 6.00	″ 5.10	11.10
15....	″ 6.00	″ 5.10	11.10
16....	″ 6.00	″ 5.20	11.20
17....	″ 6.00	″ 5.20	11.20
18....	″ 6.20	″ 5.20	11.00
19....	″ 7.20	″ 5.20	10.00
20....	″ 8.30	″ 5.20	8.50
21....	″ 9.30	″ 5.20	7.50
22....	″ 10.50	″ 5.20	6.30
23....	″ 11.00	″ 5.20	6.20
24....	....	″ 5.30	5.20
25....	A.M. 12.10	....	
26....	″ 2.10	″ 5.30	3.20
27....	No Light.	No Light.	.....
28....	No Light.	No Light.	.....
29....	No Light.	No Light.	.....
30....	P.M. 5.30	P.M. 8.30	3.00
31....	″ 5.30	″ 8.30	3.00
		Total......	189.40

When we have tight and loose pulleys and a belt to ship we naturally put the belt shipper as near the driven pulleys on the countershaft as possible. There are many mechanics who have never thought of putting the shipper anywhere else and who probably could only with difficulty be persuaded to do so. As a matter of fact there are many cases in which, where the tight and loose pulleys are of the same diameter, with straight faces, and where very quick and frequent shipping of the belt is not required, it is much better to place the shipper near the driving pulley on the lineshaft, to operate on the belt as it approaches that pulley.—American Machinist.

MR. CHARLES MOSELEY.

MANY engineers and readers of this journal will recognize in the accompanying portrait the countenance of Mr. Charles Moseley, President of Toronto No. 1, C.A.S.E., and chief engineer of the Toronto Incandescent Light Company on Terauley street. Mr. Moseley was born at Chart, Sutton, County of Kent, England, in the year 1860. At the early age of eleven years he commenced his mechanical education in the machine shop of Steaven, Hooker & Co., who were so impressed by the thoroughness of his work, and his evident ability, that they gave him full charge of their steam plant and repair shop, although at that time he was but 16 years of age. He remained with Messrs. Steaven, Hooker & Co. for over ten years. In 1884 he left his native land and sailed for Canada. Arriving in Toronto, he secured a position with Mr. John Fletcher, a well-known builder and contractor, as engineer; all the machinery on the premises being under his control. He remained with Mr. Fletcher for six years, leaving to accept a position with the Mail Publishing Co., Toronto, but after six months returned to his former employer, for whom he worked one year.

Later Mr. Moseley secured the position of engineer of the North Toronto Electric Light and Waterworks, and in August, 1893, he accepted his present responsible position as chief engineer of the Incandescent Electric Light Co., on Terauley street. The plant under his charge is one of the most efficient in the city. There are two Babcock & Wilcox boilers of 225 horse power each, fitted with two Jones stokers under each boiler, and six tubular boilers of 125 h.p. each. The engine capacity consists of one vertical compound of 600 h.p., three Armington & Sims of 200 h.p. each, and two straight lines; while two 200 kilowatt direct acting dynamos, four 100 k.w. and four 60 k.w. machines, comprise the electrical equipment.

MR. CHARLES MOSELEY.

Mr. Moseley has always taken an active interest in the Canadian Association of Stationary Engineers, and in July last was elected president of the Toronto Association. A paper from his pen on "Economy in the Boiler Room," read at the recent annual convention of the association, will be found on another page.

QUESTIONS AND ANSWERS.

"C. B.," Kingston, Ont., writes: "Kindly inform me if mica can be reduced to an oil and by what substance. Will it form an alloy such as silver? Will mica retain its original properties when in liquid form?

ANSWER.—Mica occurs in various forms, chiefly as tri-silicate of the alkaline earth metals, usually magnesium and potassium, and cannot be reduced to an oil retaining its physical properties or elementary chemical composition. No doubt the elements composing mica could be combined with other minerals to form an alloy, but would have no particular value.

COMPRESSED PEAT AS FUEL.

In every manufacturing establishment where power is generated by means of steam, the cost of fuel is one of the largest items of expense. The possibility of securing some fuel cheaper than coal has been investigated by scientists in earlier years, but little has been accomplished that would lead them even to anticipate success. It is natural, therefore, that widespread interest is manifested in the present and prospective operations of the Canadian Peat Fuel Company, which has for its object the utilization, for the purposes of fuel, of the immense peat bogs to be found in Canada. That this particular class of fuel is destined to supersede coal may be a question in doubt, yet we believe the progress that has been made by the above-named company, and the results attained by experiments, are sufficient to warrant some reference to the subject in this journal. It is a question in which central station managers, and steam users in general, are interested.

That peat has been used as fuel in European countries for many years is well known. The method of converting it to the desired form for burning has consisted in reducing the peat to a paste by the addition of water, and then pressing the wet peat into the form of briquettes, and drying these blocks in the open air or in a kiln. Some scientists have aimed at the reduction of the moisture by different applications of artificial heat, and endeavored to increase the output of the manufactured material by various mechanical arrrangements. The objection to the above methods is that peat cannot properly be consolidated while it is wet. With a full recognition of these facts, and after much experimental work, Mr. A. A. Dickson, of Toronto, has discovered a method which would seem to entirely solve the problem of utilizing the product of peat bogs as fuel. Mr. Dickson has investigated very extensive tracts of peat bog in Canada, and has obtained a patent on a valuable machine for the conversion of the crude material into compressed peat. The Canadian Peat Fuel Company, in which he holds a controlling interest, and which is capitalized at $1,500,000, have in operation a plant at Welland, Ont., where they own a peat bog of some 5,000 acres in extent.

The origin of peat bogs is so well understood as to require little explanation. They occur in low situations, or where some natural or artificial obstacle impedes the drainage, and extend sometimes to a depth of ten feet. By virtue of their immense stores of carbon, they constitute a potential source of fuel supply.

The process of manufacture, as at present employed at the company's works near Welland, consists, first, of the excavation and drainage of the peat at the bog and its natural drying in the open air, until the material retains only approximately the same humidity as the atmosphere. It is then ready for manufacture, and the next step is the reduction or disintegration of the dried mass until it assumes a pulverized character. This is accomplished by means of a breaker, which revolves at a high rate of speed, and breaks the material to powder with iron teeth. The fibre, however, is preserved free from any undue fracture, and without liberating any of the indigenous or inherent combustible matters. From the breaker an exhaust fan draws the powder into a large hopper, from which it descends to the machine, where it is stamped into cylinders two inches wide, and of the same depth. The peat is here reduced by pressure to cylindrical blocks of about two inches in a tube without bottom, the resistance to the enormous pressure of some thirty tons being entirely obtained by the friction of the material against the side of the tube. The reduction of bulk from the raw material to the finished block is in the proportion of 6 to 1. The product ready for burning takes the form of a block about 3 inches in length and 2 inches in diameter, very hard and dense, and containing all the fibrous, carbonaceous, volatile and other materials and elements which are originally embodied in raw peat, and an amount of moisture only corresponding approximately with that in the surrounding atmosphere. The patent vertical press, built of cast steel, the invention of Mr. Dickson, with a moderate expenditure of driving power and only two formers or dies, working against a yielding resistance, has an output of about 1½ tons of pressed peat per hour, but it is proposed to build machines of much greater capacity at an early date. The gear type of compressing machine now in operation is run by a small engine, but ere long a new type of press, carrying its own steam cylinders, running at a much higher rate of speed and producing fully twice the quantity of fuel per hour, will be adopted.

Peat Bog at Welland, Ont., showing Buildings of Canadian Peat Fuel Company.

One gear machine is in operation at the Toronto Industrial Exhibition now in progress, and a personal inspection convinced the writer of the wonderful results being accomplished. The furnace firing the boiler was fueled by the compressed peat, and a particularly bright and strong fire was observable. The fuel is said to be non-triable and weatherproof by reason of its solidity and the external glaze imparted to it by frictional contact with the forming dies. The inherent moisture of the peat is reduced to 12 per cent. The weight of the fuel is given as 83 pounds per cubic foot, while bituminous coal weighs 73 pounds and anthracite coal 93 pounds per cubic foot. Other qualities of this fuel are claimed to be freedom from sulphur, and that it makes neither smoke, soot, dust nor clinkers during consumption.

Experimental tests have been made, the results of which show that the fuel bids fair to become a strong competitor with coal. On December 28th, 1897, a test was made at the power house of the Metropolitan Street Railway Company, North Toronto. It occupied twelve hours, and was made in competition with a first-class quality of coal. For the information of our readers, we give below the actual results as submitted by Mr. James Milne, electrical engineer :

	Coal.	Peat.
Duration of test in hours	12	7
Average E.H.P	42	46
Average I.H.P.	60.8	65
Total fuel burned in lbs	4,195	2,984
Average steam pressure	88	90
Average feed water temperature	102 deg. Fah.	50 deg. Fah.
Hourly fuel consumption in lbs.	349.6	426.3
Fuel per E.H.P. hour in lbs. observed	8.32	9.267
Fuel per I.H.P. hour in lbs. observed	5.768	6.558
Total ash in lbs	250	68
Percentage of ash	6 p.c.	2.28 p.c.
Relative value of fuels as per indicator diagrams (actual conditions)	100	86.3
Relative value of fuels per indicator diagrams, taking difference in feed water temperature and steam pressure into account	100	90
Relative value of fuels as per ammeter readings (actual conditions)	100	88.6
Relative value of fuels as per ammeter readings, taking difference in feed water temperature and steam pressure into account	100	92.3
Mean of No. 14 and No. 16	100	91.15

Had grate bars been arranged to suit the new fuel, it is claimed that very much better results could have been attained.

A few weeks ago a test was made on the steamer Primrose, of the Toronto Ferry Company, and the certificate of the chief engineer states that for quick steaming this fuel proved superior to coal, quantity consumed was not greater, smoke was not visible at any time, and ash was very much less. The report of the fireman running one of the Sawyer-Massey Company's portable engines at the Toronto Exhibition says : "For quick steaming I never used fuel to equal peat. It is quite as economical as coal, and in many respects greatly superior. It is smokeless, cleanly to handle, very little ash, and no sulphurous gas, consequently makes no soot to gather on the tubes. I find the stoking much easier than with coal. I banked the fire at 5:30 p.m., closing off the drafts, and found plenty of fire next morning at 7 a.m., with 60 lbs. of steam up. When the fire has burned out I find the grate bars perfectly clean."

It is contended that the cost of production is no greater than that of mining coal, while there will be a great saving in freight owing to the close proximity of the peat beds. As tracts of peat bog are to be found in nearly every part of Canada, it is the intention of the Canadian Peat Fuel Company, who control patents for Canada, to dispose of county rights. In fact, some of these have already been sold. In this way it is believed that electric lighting stations will be enabled to obtain compressed peat cheaper than slack coal, which is now used almost exclusively. Although the development of the industry has only commenced, it is reported that local companies who have secured patent rights are making quotations of $3 per ton net at the works, and it is believed that it will be possible to lower this figure considerably.

The Parry Sound Electric Light Company have, owing to increase of business, found it necessary to increase their capacity, and have closed a contract with Mr. Charles Barber, of Meaford, for a pair of 42 inch horizontal water wheels.

Later reports show that the damage to the works of the Jenckes Machine Co., at Sherbrooke, Que., by fire on the night of the 13th of August, was very much exaggerated. The fire was confined to the machine shop building, and the other departments, foundry, boiler shops, etc., were in operation as usual on the following Monday. A few days later a portion of the machine shop was started up, and the whole was in running order by the 23rd of August. The patterns, drawings and office records were preserved practically intact, and all orders for work are being accepted as usual. The principal item requiring replacement is the roof of the machine shop; this, however, is well under way. The whole of the work is being pushed with much energy, and the numerous orders in hand will suffer comparatively slight delay.

SPECIFICATIONS FOR ELECTRIC PLANT FOR CITY OF LONDON, ONT.

TENDERS were recently invited by the city of London, Ont., for the supply of an arc lighting and steam plant, upon specifications prepared by the City Engineer. At the council meeting held for the purpose of considering the tenders submitted, a letter was read from a company engaged in the manufacture of electrical apparatus, contending that the specifications were so worded as to exclude many manufacturers from tendering. We publish herewith a copy of the specifications for the arc lighting plant, and invite electrical machinery manufacturers and engineers to express their opinions as to the adaptability of the same, with a view of learning how far they meet with general approval. The specifications were, of course, prefaced by the usual instructions regarding the carrying out of the work.

SPECIFICATIONS FOR ARC PLANT.

DYNAMOS.—The contractor shall furnish and install the following dynamos, apparatus and material : Four (4) arc light dynamos, direct current, each having a capacity of 100 and to have a guaranteed efficiency of not less than 86%, 2000 candle power, 9.6 ampere, 45 volt arc lamps. Each dynamo shall be provided with an automatic regulator, which shall automatically make the proper adjustments for all changes of load from no load to full load, the adjustments to be made in such a way as not to endanger any part of the dynamo, appliances or lamps, nor to cause any perceptible change in the balance remaining in operation. These dynamos shall be of the............... system and of the latest and most efficient pattern, mounted on a base provided with an adjustable belt tightener, so that the belt may be tightened while in operation, and capable of operating at full load for fifteen consecutive hours without increasing the temperature of any part, especially the armature, fields and commutator not to exceed 70 degrees over surrounding atmosphere or to such a degree as to endanger the insulation or decrease the efficiency of operation ; shall have an insulation resistance of not less than 250,000 ohms between all parts insulated from each other ; shall be adapted to operate at a speed not exceeding 900 revolutions per minute at full rated load, including 84 miles of circuit wire ; shall be provided with efficient self-oiling bearings, having flexible bearings of the ball pattern and equipped with sight glasses so as to determine at all times the level of the oil in the reservoir. The armatures shall be balanced both electrically and mechanically, so that there will be no tendency to strain the shaft or to draw the armature towards either bearing so as to cause any excessive friction and heating, and no vibration. Special pains shall be taken with the insulation, protection and separation of contacts, binding posts and bare surfaces having extreme differences of potential in order to minimize the danger of accidental shocks, crosses or grounds under normal conditions of operation. The dynamos shall be so designed and automatically regulated that the power will be automatically proportioned to the number of lamps burning at any time. On each dynamo is to be placed one switch for short-circuiting the armature. Each dynamo is to be equipped with a pulley of properly proportioned dimensions and having the proper width, face and diameter to successfully transmit the necessary power to operate them at their rated speed under all conditions of load. Each dynamo is to be equipped with a spare sets of brushes, and if removable segments are used, to have also a spare set of segments. These dynamos are to be placed in the lighting station in London on suitable foundations which will be furnished by the purchaser. There shall be provided with each dynamo in addition to the automatic regulator referred to above, one controller for standardizing the current and making it constant at all times under all variations of load, and also one ampere metre for indicating the current supplied by the dynamo, said ampere metre to be properly calibrated ; also one main switch and two efficient lightning arresters of the.............. pattern. Supply all necessary double belting required, of first-class material.

GUARANTEE OF DYNAMOS.—The contractor will guarantee each dynamo furnished to be fit for operating daily, for 18 hours of a continuous run at its rated output, or any less output ; to be free from defective material, and to withstand without injury the sudden breaking of the circuit when running at full load, or a sudden short circuit of the lamp circuit, said short circuit to remain on for five minutes without any attention being given to the machine. He will undertake to replace, free of charge, each armature or field coil which may burn out, or otherwise become defective in any manner, or from any cause, within one year after the acceptance of same, unless it shall be proved to the engineer without question that the defect was due to the fault of the city's employees.

TESTING INSTRUMENTS.—With the above four (4) dynamos is to be furnished one portable ammeter, Weston make, having a scale from zero to 20 amperes, the same to be dead beat, direct reading, and capable of being left in the current all the time, without damage or altering of the calibration. Also one volt metre, Weston make, scale 10 volts to 75 volts ; both these are to be portable, so that the current can be read from any part of the city. Also two testing magnetos, capable of ringing through 50,000 ohms, are to be supplied with the entire plant.

ARC LAMPS.—There shall be provided 350 Adams-Bagnell arc lamps of 2000 nominal candle power, the same to be single carbon, having carbon holders of the proper size to hold 7/16 to 5/8 carbon. Each lamp will be provided with a switch by which it may be cut in or out of circuit ; shall be regular in its feeding action ; shall be free from hissing, flickering or flaming when provided with ordinary commercial standard carbons ; shall have no complicated clock-work mechanism ; shall contain an efficient device which shall automatically cut out a lamp for any reason defective, without interfering with the operation of the remaining lamps in circuit ; shall be simple, strong and durable in its mechanical construction, and must be thoroughly protected with a weather-proof hood of an approved design, and provided with an absolute cut-off.

Lamp Guarantee.—The contractor will guarantee each lamp furnished by him to be free from all defective material, and perfect in workmanship, and to be in all respects in accordance with the specifications and with the statement made by him in writing in his bid. Said insulation of lamps to be able to withstand the difference of potential of 5000 volts, if so required. No lamp will be accepted until it has been run on the circuits for a period of 90 days; if any defect should show during the period, the lamp or lamps to be replaced for new ones by the contractor.

Hangers.—The contractor shall furnish 200 lamp hangers of a suitable design, which are to be placed on the poles extending therefrom not less than nine feet, the same to be so arranged as to permit of easy access to the lamps for the purpose of trimming same or repairing.

Hanging Equipments.—The contractor shall also furnish 350 complete equipments, consisting of pulleys, cable ⅝ Manilla rope, reels, etc., necessary for the erecting of 350 lamps in the centre of the streets between the poles. The cables to be of iron flexible wire of sufficient strength to safely carry the weight of the complete lamps, as well as the pulleys, etc. The pulleys shall be of the latest approved safety pattern, so that in the event of a rope breaking, the lamp will not fall to the ground. These equipments are to allow for lowering the lamps to the ground for the purposes of testing or trimming.

Globes.—The contractor shall furnish 350 clear glass globes, the same to be not less than 12 inches high and 11 inches diameter.

Carbons.—The contractor shall furnish all necessary carbons to start the plant.

Switch-Board Apparatus and Connections.—The contractor must furnish and erect in the lighting station one marble switch-board of an approved design, with a capacity for 12 circuits and 12 dynamos, and provided with the necessary sockets, plugs, main and transfer cables, testing connections and a suitable and convenient device for holding cables when not in use. It shall be so arranged and marked that any circuit or series of circuits may be quickly connected with or disconnected from any dynamo with the least possible danger of short circuits or error. Sockets shall be so designed that it is practically impossible to short circuit, ground, or receive a shock from them. All connections shall be easily accessible, and made at back of switch-board. All wires used in making connections must be flexible, and have a carrying capacity of not less than 40,000 circular mills, and must be composed of 30 or more strands, to be thoroughly insulated and covered outside of the insulation with flexible rubber tube. All connections must be made in such a way as to ensure good and sufficient contact to prevent heating and ensure permanency. Connecting wires shall be so arranged and secured that crosses or ground are impossible in the normal operation of the plant.

Absolute Cut-Outs.—The contractor shall also furnish 50 absolute cut-outs, which are to be placed in locations as laid out by the city engineer, for the purpose of absolutely cutting off any portion of loop of a circuit that may be necessary. These cut-outs are to be thoroughly protected from the weather and inclosed in suitable iron boxes with glass fronts.

Installation.—The contractor shall place all the above mentioned dynamos, station apparatus and switch-board in suitable locations in the lighting station at London, and furnish all the necessary wire, to be No. 4 stranded rubber covered, gauge and properly run with porcelain knobs to the different outlets in the cupola of the building, furnishing all the necessary material and leaving the dynamos and station apparatus so that the outside circuits can be connected thereto, the belts placed from the power and ready for operation.

Designs.—The contractor must accompany his tender with designs of his dynamos, lamps, hangers, station apparatus, switchboard, cut-outs, etc., and furnish any other information not enumerated herein.

Line Construction.—The poles must be straight, select and shave pointed cedar poles, sound and free from knots, and shall be not less than 6" diameter at the top, and poles subject to extra strain shall be not less than 7" at the top. The poles on Dundas street from Ridout to Wellington, and on Richmond street from G. T. R. to Fullarton street, shall be not less than 70 feet long, clear of the ground, and set at least 6 feet in the ground. The other poles shall be not less than 35 feet clear of the ground, and set 5 feet in the ground. The poles are to have the necessary gains carefully cut so that the cross arms make a snug fit and stand at right angles to the poles. The cross arms shall be of white pine, thoroughly seasoned, sound and free from knots, and painted. These cross arms are to be not less than 60" long and dressed to 3 x 4½", with a slight pitched top, and are to have four or more oak pins in each, fitting closely in the cross arm and nailed in place and braced with two iron braces. Pins on each side of poles where four pins or larger cross arms are to be used must be less than 17" between centres. The contractor is to furnish all the necessary glass insulators of the standard pattern suitable for the wire they are to hold. All poles on which cut-outs or lamps are placed shall be stepped with spikes not less than ⅝" square and 9" long, with heads, and to be placed on each side of the pole at distances not exceeding 3 feet apart, making a step at every 18 inches.

Wire.—The contractor shall furnish all the necessary wire for connecting the lamps in circuits, as shown on the plan. Not more than 50 lamps are to be connected on any one circuit running out of the lighting station, and all outside wire used in this installation shall be not less than No. 6 B & S gauge pure lake copper, having a conductivity of at least 98%. This wire is to be covered with a triple covering of insulating material and braided with two braids, (samples of wire to be submitted with the tenders). Each circuit shall test out, with an insulation resistance, after everything is connected, of not less than 50,000 ohms per mile. All wires shall be so handled as to avoid kinking, and are not to be dragged along the ground, over cross arms or through trees in such a way as to injure insulation, and shall not be allowed to sag unduly between supports, proper allowance being made for contraction and expansion with changes of temperature. All necessary precautions shall be taken in passing through trees, crossing other lines, turning covers, etc. The joints shall be mechanically strong and secure so that no movements of the two ends relative to each other is possible. All joints must be carefully soldered, the joint being wiped free from any excess of flux, and the solder will be relied on only to give good electrical connection. Each joint is to be thoroughly wrapped after soldering with a good quality of rubber tape. The contractor will be expected to construct all the lines, furnishing all the necessary material and labor and connect the hangers, lamps, cut-outs, place the hoods and globes, trim the lamps and leave everything in first-class running order.

Additions and Deductions.—While this specification is intended to represent very closely the number of lamps to be installed, yet, as some changes may become necessary during the process of construction, the contractor must mention in his tender a price to be added to or deducted from the contract price for each lamp installed in excess of the number specified, or which shall be cancelled provided such addition or cancellation involves no change in the work already completed and shall be along the line of existing circuits. Each bidder must specify distinctly, on a separate sheet, the exact amount of material he proposes to furnish in carrying out this contract.

Guy Wires.—The poles subjected to extra strain shall be securely guyed to the satisfaction of the city engineer. The whole of this work is to be done to the entire satisfaction of the city engineer, and the entire installation is also to conform to the rules as laid down by the Board of Fire Underwriters and subject to inspection and the acceptance of an electrical expert, who is to be selected by the city engineer.

TRADE NOTES.

The Electric Co. of Windsor, N. S., has ordered a 100 horse power Robb-Armstrong engine from the Robb Engineering Co.

Mr. Carman O'Dell, of Annapolis, N. S., is increasing his electric lighting plant by the addition of a 50 k.w. "S.K.C." generator.

The Rossland Water & Light Company have purchased from the Canadian General Electric Company two of their standard three phase motors.

The Jacques Cartier Pulp & Paper Co., of Pont Rouge, Que., have arranged to light their new pulp and paper mills by electricity. The order for the plant has been placed with the Royal Electric Co., of Montreal, and is to be installed immediately.

The Canadian General Electric Co., Limited, have placed in stock a large and complete line of transformers of their different types, from which prompt shipments can be made. The C. G. E. Co. also carry a very large and well assorted stock of all lines of electrical supplies ready for shipment on a moment's notice.

The Windsor Electric Light & Power Co., of Windsor, N.S., are enlarging their recently installed electric lighting plant. They are adding one 100 k.w. and one 40 k.w. "S.K.C." generator, with an additional complement of transformers and material. The "S.K.C." apparatus and generators are from the Royal Electric Co., Montreal.

A number of very large annunciators have recently been turned out of the factory of Ness, McLaren & Bate, Montreal, including those for the new Place Viger Hotel, Montreal; Chateau Saguenay, Chicoutimi, and Ladousac Hotel, Ladousac. All these annunciators are equipped with Norway iron gravity drops, manufactured exclusively in Canada by this firm.

A letter from the Newton Appliance Company, of New York, states that they have about 2,000 Flush switches of what is called their No. 1 tact that they offer for sale at a reduced figure. They are similar in every respect to their standard Flush switch, except that that they are three inches deep over all, which is one-half inch deeper than their standard switch. This extra depth was an error in making up the porcelain, and it prohibits their use in the standard iron boxes, in which Flush switches are used in the United States. Some 5,000 of these No. 1 switches were made up, but 3,000 were disposed of—some in Europe and some in Canada. Quotations on these switches may be obtained from their Canadian representatives, Messrs. Munderloh & Co., of Montreal.

The Wm. Sutton Compound Co. of Toronto, Limited, report that since having placed a representative in Montreal they are well pleased with the large volume of business secured from the largest and best steam users in that city and the province of Quebec. As this is a new and permanent field for their agents, the present success is more than gratifying, and they feel assured that they will have before many months the largest boiler compound trade in that district. Their business in all parts of Canada shows a marked improvement, having been 30 per cent. greater during the last six months than in the corresponding months of last year. This they claim is due to the standard quality of the Sutton boiler compound, which never fails when honestly tried. It is used extensively by breweries, steam bakeries, dyers and laundries, without the slightest injury to their products.

We are pleased to bring before the notice of our readers a new departure made by the Electrical Maintenance & Construction Company, of Toronto, who have opened an office at 609 Temple Building, with Mr. P. H. Patriarche as manager. The object of the company is to do all sorts of construction work and maintain electrical apparatus of all descriptions at an agreed rate per annum, the rate of course being governed by the size and condition of the apparatus or machinery to be maintained. This would seem to offer an inducement to manufacturers and others to use electricity to a greater extent in their operations, as in this way they can limit the cost of repairs to a fixed sum per annum. Mr. P. H. Patriarche has been for many years in the employ of the Toronto Electric Light Company, having started at the bottom and worked his way steadily upward. Under his management the company should meet with success.

PATENT RIGHTS.

Concerning the methods adopted to obtain patents in Canada, a correspondent writes to the Electrical News as follows:

When anyone secures a patent, he is generally of the opinion that he has the right to manufacture, sell or otherwise dispose of the article patented. This is without doubt a fallacy, which can readily be seen from the following:

The device may have been patented before it may have been in use in other countries for over the time limit as set by the Canadian Act respecting patents of invention. It is a well-known fact that some take a pride in openly stating that no matter what patent is granted, they can get another patent through for practically the same thing without infringing on the former patent. What is the result of this second patent? The result is invariably a law-suit, much to the detriment of the original inventor; and the burden of proof as a rule lies on the original inventor. Just as soon as any useful article has been put on the market and there is a good demand for this article (take the Auer light for example), you will find that there are certain parties who will set to work and closely examine the patents with a view of ascertaining if they can in any way be overcome, and unless the principle is patented they have great chances of success, owing to the fact that the original inventor may have been a little loose in drawing up his specifications and claims, or may have entrusted same to a second party, who, perhaps, did not realize the great importance of covering certain points; or the inventor, anxious to secure his patent, may have overlooked some of these important points. The first inventor, and the man to whom credit is justly due for the invention, may have spent a large amount of time and money in perfecting a machine, yet through a small oversight in his claims, a second party is allowed to patent practically the same machine as he invented, and for which the second party has spent neither time nor money, except in examining the patent.

I know of a case in the United States where an inventor sold his patents to a company. In this company there was a certain party who wished to get control, but who could not do so honestly, so he started out with an infringing device. Now, what method did this party adopt? He searched the patent records until he came across a device that might be construed in a measure to cover the machine he intended to get up. Bear in mind that this party knew no more about this machine before he went into this company than the man in the moon, yet he bought up this old patent and went to work on same, made the infringing device, and was in a measure successful, and will continue until the matter is definitely decided in the United States court.

You will, therefore, understand how things go; this particular party could not get control of the original company by fair means, so he set to work to make a similar machine, with a hope of being bought up in order to stop competition in this particular device. There is surely some redress. At present, however, the only redress is to take action against the users of infringing devices. It is a very costly action, and it would appear that there is room for some board of commissioners to examine patents before they are granted, and to see if same can be patented, and that they do not infringe on anything that has been previously patented.

Some patent solicitors are very straightforward in this matter, and before setting out to obtain a patent first examine the records to ascertain if the invention is new, etc. This is without doubt the proper course, but the inventor may say that he wants his patent if it is possible to get it, whether same has already been patented or not. The patent solicitor therefore proceeds, and draws up the specifications and claims, knowing full well that this particular patent is of no use whatever. The patent, however, is got through. The article is then put on the market and the war commences. The company or party owning the original invention notifies all users of the infringing device that action will be taken in the matter. Owing to the fact that it takes such a long time for a matter of this kind to be settled, and until such time as it is settled the party with the so-called infringing device is hurrying around the country taking orders and cutting prices, and making it very hard for the original company, this company, having also been at the expense of doing the missionary work in connection with this particular article, so far as advertising is concerned, cannot afford to sell the article at such a low figure, but in the meantime must come down to the figure of the second party or get out of business.

It is very true that some inventors may claim more than they are justly entitled to under the patent, but this is readily settled according to the Act Respecting Patents. We understand that the German government defends the patents taken out by original inventors, and we think there is room for such a course in this country. Canada is the easiest country in the world in which to obtain patents, for same are granted without any regard whatever to former patents issued.

MARITIME ELECTRICAL ASSOCIATION.

A meeting of the Executive Committee of the Maritime Electrical Association was held in Halifax on August 16th, at which two new members were elected. Mr. Colpitt presented the report of the local committee on arrangements for the first annual convention. It has been decided to hold the convention in the city of Halifax on Tuesday, September 27th, simultaneous with the Halifax exhibition. Therefore it will be possible for delegates to the convention to obtain cheap railway fares. Two sessions will be held, one at 9.30 a.m., and the other at 3 p.m. Invitations have been received by the executive of the association to visit the plants of the several electrical companies, and it is proposed that there should be an excursion by steamer on the harbor.

At the last meeting of the association, it was decided to furnish reports of all meetings to the Canadian Electrical News for publication.

PERSONAL.

The city council of Toronto have decided to engage Mr. James Milne, E.E., to report as to the number of electric lights required for lighting the new municipal buildings.

Mr. George F. Macdonald, of Ottawa, Ont., was elected vice-president of the International Association of Municipal Engineers at the recent convention of that association.

Mr. James O'Rourke, late engineer of the Long Pointe asylum, sailed from Montreal last month for Great Britain and Switzerland, for the benefit of his health. Mr. O'Rourke will return in November.

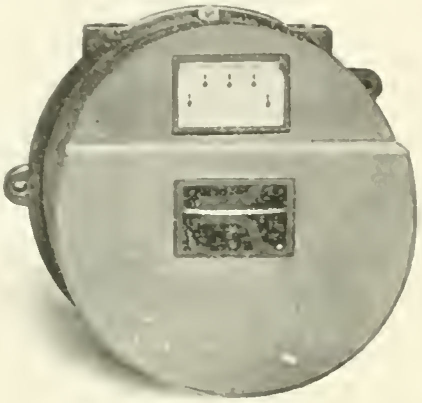
Mr. James Stevenson, who for several years has been employed as electrician by Mr. L. H. Reesor, of St. Marys, Ont., has accepted a position with the Stratford Electric Light Company.

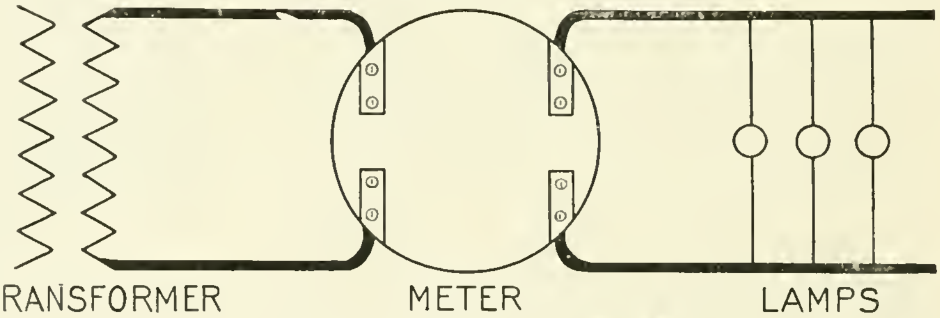
Mr. James W. Woodward, foreman of the wire department at the works of the Canadian General Electric Company, Peterboro', has tendered his resignation, to accept a similar position with the Royal Electric Company at Montreal.

The General Engineering Co. of Ontario advise us that they have installed or are installing the following: Six improved Jones underfeed stokers for the Laurentide Pulp Co., Grand Mere, Que.; two at the C.P.R., Dalhousie sq. station, Montreal; one for Rhodes, Curry & Co., Amherst, N.S.; one for Truro Condensed Milk & Canning Co., Truro, N.S.; one for Slingsby Mfg. Co., Brantford, Ont.; twelve for Toronto Street Railway Co; one for Windsor Hotel, Montreal, and twelve for the Maritime Sulphite Fibre Co., of Chatham, N. B. The Toronto Railway plant will be one of the most complete of its kind in existence. The coal will be fed by gravity into the hoppers, and the firemen will not handle same at all. The blower plant will consist of two 90 inch steel plate fans, each capable of delivering 22,000 cubic feet of air per minute. These fans are driven direct by electric motors, and the draft automatically controlled. With the improved Jones stokers about 150 cubic feet of air at about 1½ oz. pressure at the tuyeres are required per pound of coal per minute; therefore it will be seen that with blowers of the above capacity four tons of coal can be burned per hour on the twelve furnaces; the average burning will be about 2.75 tons. Owing to the magnitude of this boiler plant, viz., 5,000 h.p., a duplicate blower system is being installed, it being realized that electric motors are not infallible. The air piping throughout will be of sheet steel and all joints rivetted. The boilers are of the Scotch marine type. The report of a competitive test made between the improved Jones and hand firing will be sent by the General Engineering Co. on application.

THE NEW SCHEEFFER RECORDING WATT METER.

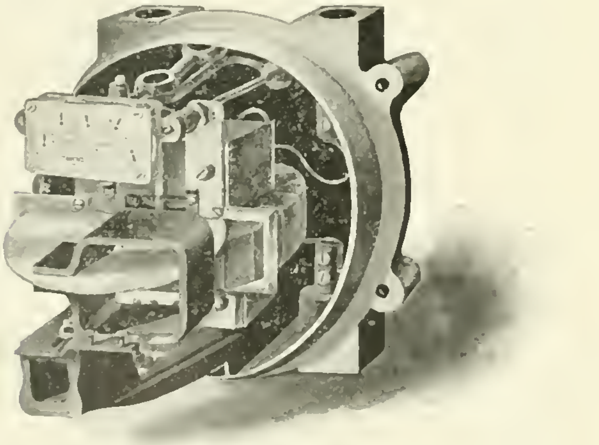
The Packard Electric Co., Limited, of St. Catharines, Ont., has recently placed upon the market the new Scheeffer watt meter for alternating current, concerning which the manufacturers say: This meter has been devised to correct the various faults which exist in other meters to-day. It will be seen by the accompanying cuts that the meter is round and has a rubber band placed around the circumference, over which is placed the case. By the use of this rubber band the meter is rendered perfectly air tight and also is made perfectly dust and bug proof. It has been found that meters with cases of ordinary fitting are hampered with dust and dirt, and when such cases are used it is impossible to keep meters correct, even with frequent over-hauling and cleaning. The binding posts of the new Scheeffer meter are insulated in a most thorough manner; no ordinary holes being depended upon. These holes are closed on end, making it impossible that anything can get through the post and also doing away with the necessity of plugging the holes.


New Scheeffer Watt Meter—With Case.



Connections of the New Scheefer Watt Meter.

The new Scheeffer meter does away with the revolving cylinder, only retaining the revolving disc of aluminum, thereby making the moving parts extremely light, but at the same time not too delicate. The iron circuit in the magnetic system is practically a closed one, preventing stray lines of force from acting on other parts of the meter, and is therefore unaffected by outside influences. This closed circuit is said to give the maximum effect with the minimum energy possible in construction, the shunt winding only taking from 1 to $1\frac{1}{3}$ watts on 15,000 alternations, and not exceeding $1\frac{1}{2}$ to $1\frac{3}{4}$ watts on 7,200 alternations.


New Scheeffer Watt Meter—Without Case.

One valuable feature in the new Scheeffer watt meter for central stations to consider is its correctness on inductive loads, and it can therefore be used on fan motors or induction motors, arc lamps, etc. The meter is extremely compact and requires but a small space for its placing.

It has been found by experience that a central electric lighting station can supply 30 per cent. more customers on the "meter" than on the "flat" rate. This 30 per cent. really represents wastefulness, which is inherent in the nature of the average customer and the "flat" rate. The investment in meters and their proper care make the plant equivalent to 30 per cent. larger. A central station which is in the electric lighting business for the profits on its investment can easily realize the great advantage in the use of meters. That many small villages and cities make but a small profit or the income only sufficient to pay actual running expenses, is not surprising in view of the waste and extravagance of the "flat" rate. These same stations may, by proper and economical use of meters, be made profitable.

It is not necessary to point out the evils of the "flat" rate; but it is self-evident that many customers never take the the trouble to turn out all or part of their lamps, and in places where the plant gives all night service the lamps are left burning all night. A fallacy in flat rates is the basing of charges on 50 watt lamps. A 50 watt 16 c.p. lamp is somewhat of a rarity in the market, 60 watt being about an average, and many lamps are used taking more even, 70 or 80 watts. In most small stations the voltage is kept above what the lamps are made for; even in the case of a 50 watt lamp the consumption will be higher. We have found that most small stations if they use 50 volts, keep the voltage at 55 or 60. These wastes are impossible to avoid in the "flat" rate.

A meter measures the actual consumption of current. The central station gets paid for actual service given the customer, and it behooves the customer to use his lights in the best and most economical way.

A LONG DISTANCE TRANSMISSION.

Friday, the 26th day of August, 1898, will be memorable in the annals of electricity in Canada, being the day on which the Cataract Power Co., of Hamilton, turned the first current on to their long distance transmission line between Decew Falls and Hamilton. The water was let into the fore bays and pipe line at about 3 p.m., and at 3.30 p.m. the hydraulic plant, consisting of two 1500 h.p. water wheels, and the electrical plant of two 1000 k.w. S.K.C. generators, were turned over, the switch closed and the power transmitted to Hamilton, a distance of 35 miles, where it was utilized for lighting arc and incandescent lamps, and also for driving a 40 h.p. S.K.C. induction motor. The incandescent lamps in the sub-station in Hamilton were very artistically arranged in the form of a large star and maple leaf, and were kept lighted until far into the night. It is expected the works will start permanently within a few days.

The Canadian Manufacturers' Association have begun the publication of a Bulletin, to be issued monthly, or oftener, as occasion may require, which will contain the latest and most reliable information regarding the possibilities of the export trade of Canadian manufactures. This information is obtained from the Dominion Department of Trade and Commerce, and from the publications issued by the British and United States governments, and other reliable sources.

SPARKS.

It is the intention of the Peterboro' Light and Power Co. to erect a new power house, at a cost of about $35,000.

The town of Pembroke, Ont., is securing information as to the advisability of operating an electric light plant under municipal control.

The citizens of Britannia, a suburb of Ottawa, are anxious that the Ottawa Electric Railway Company should extend its road to that place.

The contract for wiring for electric lighting the Victoria Jubilee Hospital at London has been given to the London Electric Company, at the price of $1,300.

The Canadian General Electric Company are installing a plant for Messrs. A. B. Jardine & Co., of Hespeler, Ont., who have been enlarging their premises very considerably.

"Through the Garden of Canada" is the title of a pamphlet issued by the Hamilton, Grimsby and Beamsville Electric Railway Company, descriptive of the route and scenery of that railway.

The Canada Electric Company, Montreal, have placed an order with the Canadian General Electric Company for one 85 k.w. M. P. direct current generator, to be used at Longue Pointe Asylum.

The fine new dining and sleeping cars recently turned out by the Canadian Pacific Railway Company have been equipped with annunciators manufactured by Ness, McLaren & Bate, of Montreal.

It is worthy of note that the Cork Electric Tramways & Lighting Company, Limited, is the first company in the British Isles supplying electricity for traction and lighting from one central station.

The Canadian General Electric Company have received an order from the Citizens Telephone and Electric Company, Rat Portage, Ont., for one of their standard 2000 light single-phase alternators.

The ratepayers of Perth, Ont., have again defeated the Lanark County electric railway bonus by-law. There is now said to be a scheme on foot to connect Carleton Place and Lanark by an electric road.

The C.P.R. have installed an electric light plant in their new station at McAdam Junction, N.B. The system includes both arc and incandescent light, the company supplying lights for commercial purposes.

The Ottawa Car Company, at its annual meeting last month, declared a dividend of 8 per cent., and decided to increase the capital stock to $25,000. The demand for cars has necessitated an extension of the works.

The West Kootenay Power & Light Company, Rossland, B.C., are rapidly extending their business, and for a recent extension have ordered from the Canadian General Electric Company three large feeder panels and two transformer panels.

It is contended that the Anglo-American Telegraph Company, which practically holds a monopoly of the telegraph business in Prince Edward Island, is not furnishing a satisfactory service, and if redress is not granted, competition will be invited from other companies.

The announcement is made that the Pacific Cable Company has let a contract for laying a cable from the United States to the Phillipine Islands, via Hawaii and Ladrones. It is said that the contract will be completed in six months, and that the cost will be $10,000,000.

The Hamilton Cotton Co., Hamilton, Ont., have decided to light their mills with electricity, and have placed an order with the Canadian General Electric Company for one of their 40 k.w. direct connected generators, with marble panels.

The ratepayers of Neepawa, Man., have voted to provide $12,000 to install an electric light system and $6,000 for a telephone system. The municipal authorities want applications for the position of electrician to take charge of these plants, duties to commence immediately.

A company of Winnipeg capitalists purpose utilizing a portion of the water power on the Winnipeg river. The scheme includes the establishment of an electric railway from the mouth of the Whitemouth river to points on the Winnipeg river, and the transmission of electric power to Winnipeg.

Mr. R. H. Smith, of Tilbury, Ont., whose plant was recently destroyed by fire, has placed an order with the Canadian General Electric Co. for an entirely new plant, consisting of two 15 k.w. standard Edison D.C. dynamos and one 30-light arc machine. Mr. Smith expects to have his plant running again in about two weeks.

Ness, McLaren & Bate, of Montreal, have recently added to the list of goods which they manufacture a new line of electric bells, and are now manufacturing iron box bells and iron frame bells. These they offer in competition with the best on the market, and expect to be able to lower the present prices considerably.

The city council of Toronto, Ont., have accepted the tender of the Sprague Elevator Co., of New York, for the supply of three electric elevators, with plant for five., for the new municipal buildings. The price is $26,475. The architect states that the electric plant will operate 300 or 400 lights in addition to running the elevators.

Negotiations have been pending for some time for the purchase by an American syndicate of the Niagara Central Railway. It is said to be the intention of the syndicate, which is represented by Mr. Neelon, of St. Catharines, to convert the road into an electric system, and to extend the present line to Port Dalhousie and Beamsville.

The Waterous Engine Works Co., Limited, of Brantford, Ont., are adding to their shop capacity, and are installing a 30 h.p. induction motor from the Royal Electric Co., which is to be operated from the alternating current lines of the Brantford Electric & Operating Co. This makes over 100 h.p. in S.K.C. motors now operating in Brantford.

The Metropolitan Street Railway Company will extend their line as far as Bond's Head, and will erect a new power house at Bond's Lake. It is the intention of the company to dig a canal from the lake to Yonge street, and to have a boat service between the two points. The extension of their road to Schomberg and Newmarket is also under consideration.

Mr. Carman O'Dell, who has been operating the lighting service in Annapolis, N.S., has decided to increase his lighting plant by the addition of a 50 k.w. S.K.C. two-phase generator. He is also adding considerable to his distributing mains, covering a wider area—in fact, nearly doubling the output of the plant. The order for the generator and transformers has been placed with the Royal Electric Co.

A novel and interesting use of the Niagara Falls power is found in a large candy factory at Buffalo, in which all the machinery is operated by electric motors. The chocolate dipping machines, exceedingly ingenious devices, are operated by five horse power electric motors. In another department, a machine which turns out lozenges is driven by a thirty horse power motor.

Mr. J. T. Ayers, of Lachute, Que., has secured a franchise from that town for incandescent electric lighting. For this purpose he has placed an order with the Royal Electric Company for one of their 100 k.w. S.K.C. generators and the necessary transformers and material for the construction of the entire plant. The new plant will be driven by a water power situated about two miles from the centre of the town.

Mr. Herbert Webster, formerly of the firm of Webster & Hicks, Norwich Ont., has secured a franchise for furnishing the town with electric lighting. The Canadian General Electric Company are supplying the entire electrical equipment, which consists of a 700-light single-phase alternator, marble panel switchboard, transformers and wiring. The corporation have contracted with him for the lighting of the streets by forty 32 c.p. incandescent lamps, operated in series.

The Dundas Electric Light Co. have received a franchise from the town of Dundas to furnish incandescent lights throughout the town, and also a contract for the street lighting. Both systems must be in operation by the first of November, 1898. The entire electrical equipment, consisting of a 50 k.w. S.K.C. two-phase generator, with 500 lights capacity in transformers, and all the necessary wire and material, is to be supplied by the Royal Electric Co., and the plant is to be installed at once, Mr. Geo. H. Harper, of Dundas, will be manager of the new company.

Ness, McLaren & Bate, of Montreal, have recently put on the market a new system of office telephones, combining the best features of the magneto system and warehouse battery system, and also using an automatic return switch, dipensing entirely with the service of central exchange or operator. The Montreal Witness building, in Montreal, has been equipped with a complete system of these private interior telephones. The manufacturers claim that the advantages of combining the two systems are apparent to all users of telephone instruments.

Some years ago the Montreal, Park & Island Railway entered into a contract with the town of St. Louis du Mile End, by which they were to supply the town with a first-class electric car service on the leading streets. The company failed to carry out its contract, and the corporation took action against them. The case came up for hearing before Judge Charland, who granted the company a delay of two months in which to carry out its contract. This did not meet with the approval of the Park and Island Company, and the case was taken to the Court of Appeal, where the first judgment was confirmed. Then the company endeavored to take the case to the Privy Council, but their application for appeal was thrown out.

The second general meeting of the British Columbia Electric Railways Company, which is composed of British shareholders, was held in London, England, recently. The president stated that it was again impossible to recommend a dividend on shares, as a large sum of money had been expended in improvements. It was also necessary to ask for a further sum of £100,000, which it was intended to devote towards putting Vancouver in a satisfactory position with regard to electric power. Besides the construction of the Vancouver power house, the improvements of the year included the construction of an entirely new metallic circuit for power business and two small additions to the railway. Mr. R. M. Horne-Payne and Mr. F. S. Barnard were re-elected directors.

Mr. Nelson Moore, of Guelph, Ont., has lately completed a model of an overhead electric railway. The hardwood posts from which the cars are suspended, as well as the base and the arms, are encased in steel and rivetted to prevent vibration. Two iron sockets are suspended from the arms of the post, and into these steel rails are laid. The wheels of the car are built after the manner of bicycle wheels, with steel spokes and ball bearings, which give strength, lightness and ease of motion. The framework of the car will be of strong iron or steel, and the car is suspended from the wheels to a distance of three feet from the ground. The interior is fitted with back-to-back seats, which run the entire length through the middle and are suspended from the top. The inventor claims many advantages for his overhead road. No grading or ground work has to be done in constructing the road; no bridges are required to span streams or cross ditches and ravines. Mr. Moore claims that less power would be required to operate the cars in comparison with the present systems, and that greater speed would be obtained and more effective locomotion secured.

SPARKS.

The Bell Telephone Company have placed a new switchboard in their exchange at Toronto Junction.

The Nova Scotia Telephone Company last month declared the usual half-yearly dividend of 3 per cent

The town of Cobourg, Ont, invites tenders up to October 31st for lighting the streets of the town D. H Minaker is town clerk.

Mr D A Childs has been appointed traffic manager of the British Columbia Electric Railway, to succeed Mr C Aird, who resigned recently.

The New Glasgow, N.S, Electric Company, Limited, are said to have deeded their property to secure an issue of debentures amounting to $30,000.

On August 30th a fire broke out in the power house of the London Electric Company, at London, Ont, damaging the plant to the extent of $12,000.

Mr L. E Whitehead has resigned as superintendent of the Sherbrooke Street Railway, and will be succeeded by Mr. R. R. Smith of Worcester, Mass.

Messrs. Wm Kennedy & Sons, of Owen Sound, Ont, have just installed a 40-inch Leffel water wheel for the Water, Light & Power Company of Burk s Falls, Ont

The Bell Telephone Company has notified the Quebec city authorities of its intention to place its cables and wires underground in the central part of the city.

The Metropolitan Street Railway Company are anxious to engage in electric lighting, and are seeking franchises from the municipalities along the route of the railway

The Fire, Water and Light Committee of the Winnipeg City Council has recommended that an electric wire inspector be appointed, at a salary of $60 per month.

It is rumored that the management of the Chateau Frontenac Hotel in Quebec contemplates running electric motor carriages to and from the railway stations next spring.

As the result of a disagreement between the Council of the village of Weston and the Toronto Suburban Railway Company, the car service to that village was recently discontinued by the company.

A new telephone company has been established at St. Valier, Que., by which communication is afforded between that place and St. Rathael, St. Cajetan, d'Armagh, and St. Phileon de Bellechasse.

At the works of the Royal Electric Company, Montreal, there is a cable under construction for the purpose of lighting two cotton factories by electricity. This cable will require 32,000 lbs of copper wire, and will cost over $8,000.

The Canadian Pacific Railway Co. is building, at its Montreal shops, ten handsome sleeping cars, which will be lighted by electricity, the current being generated by a dynamo operated by connection with the axle, in accordance with the system of the American Electric Lighting Company, New York.

The City Council of Nelson, B. C., has raised the sum of $40,000 by debentures for the purpose of purchasing the plant and franchise of the Nelson Electric Company. The city now owns both the water and electric light systems Messrs. J. P. Bliss and James Spwat have been appointed city electricians.

Messrs. Carroll and Smith, representing the Paris Electric and Power Company, have requested permission from the Brantford township council to erect poles and wires along the Paris road for the purpose of supplying the city of Brantford with electric power. It is the purpose of the company to utilize the water power of the Grand River.

The scheme of developing the water power of the Jacques Cartier river at Ste. Catharine, near the city of Quebec, promises to be carried into execution at an early date. A company has been organized, with a capital stock of $500,000, and Mr. Emerson McMillin as president and Mr. E. W. Cooke, of New York, as manager and vice-president.

The annual meeting of the shareholders of the Parry Sound Electric Light Company, Limited, was held in that town on Tuesday, August 30th. The following directors were elected: W H. Pratt, president; Thomas S. Walton, vice president; W. B. W. Armstrong, secretary-treasurer; J. F. Mosley, E. J Vincent, Rev. W. Evans, and J R. Stone, M.D.

A by-law to exempt the West Kootenay Power & Light Company from taxation for ten years was defeated by the ratepayers of Rossland, B.C. The company offered in return to supply the city with four arc lights. There is a movement on foot in Rossland in favor of municipal control of the electric light and waterworks systems. The Rossland Light & Power Company asks $85,000 for its assets, which is regarded by some as excessive.

The city of Victoria, B. C, received tenders as follows for arc lamps: Canadian General Electric Co., $31 25 each; R. B. McMicking, $22.50 each for second hand and $32.25 for new ones; Geo. C. Hinton & Co., $319 for twelve lamps For wire the tenderers were: Geo. C. Hinton & Co., $374.95 for 3½ miles; Nicholles & Renouf. $340; R. B. McMicking, $392 75; Canadian General Electric Co., $327 75. The tenders have been referred to the electric light committee for a report.

It is understood that a company is being formed to develop, for electrical purposes, the water power of Chaudiere Falls, near the city of Quebec. It is proposed to light the town of Levis, to pump water for the town from the St. Lawrence, and to supply electric light for the cars of the Intercolonial and other railways at Levis. It is estimated that the falls will give 5,000 horse power. A number of well-known capitalists, including ex-Mayor William Smith, of Montreal, and Mr. Henry Menier, of Anticosti fame, are interested.

The electric light plant at Paris, Ont., was recently damaged by lightning.

The Cataract Power Co., of Hamilton, has placed an order with the Royal Electric Co. for two 250 k.w. and one 180 k.w. "S.K.C." generators.

The town council of Galt, Ont., has passed a resolution that an electrical engineer be engaged to report as to the cost of a municipal electric light plant.

It is probable that the Oshawa electric railway will shortly be extended to Cedardale, where James Robson & Sons have established a large tannery.

The town of Beeton, Ont., has taken tenders for supplying an incandescent electric light plant. Mr. John Galt, C.E., of Toronto, is consulting engineer.

Arrangements are said to have been made for the building of a smelter and refinery at Cranbrook, Ont., and for the installation of a plant for generating electricity.

The statement is made that Mr. James Ross has succeeded in his Birmingham Street Railway deal, and that the road will be converted to an electric system immediately.

The Berlin & Waterloo Street Railway Company have placed an order with the Canadian General Electric Company for two G. E. 1,000 railway motors, with controllers.

It is expected that a telephone company will be formed at Gore Bay, Ont., to provide communication between that point and Meldrum Bay, Silver Water and Evansville. The distance is 58 miles.

The Bell Telephone Company are building a line between Carberry and Neepawa, Man. The company have also in contemplation the construction of a loop line between Winnipeg and Brandon.

William Wilds, electrician of the Toronto Suburban Street Railway Company, was standing on a ladder superintending some repairs to the main wire, when the guy wire broke and he was precipitated to the ground. His leg was broken at the ankle.

The tender of the Canadian General Electric Company has been accepted for the supply of electric generators for the new Victoria Hospital at London, now in course of construction. The London Electric Company will supply the switchboard, at $420.

Messrs. Culverwell and George White Fraser, promoters of the Fenelon Falls power transmission scheme, have notified the town council of Lindsay that they are now prepared to proceed with the work, the necessary capital having been subscribed and the bonds negotiated.

J. Murphy, engineer for the Cornwall Electric Street Railway, has accepted a position in Montreal. Upon severing his connection with the company, he was presented by the employees with a beautiful smoking set as a token of esteem. The presentation was made by Mr. Taylor, superintendent of the railway.

Mr. J. A. Powers has been given, by the Ontario government, a lease of a falls on the Mississaga river, in order to develop a copper mine in the township of Gould. It is said that the falls are capable of developing over 1,000 horse power. Other applications have been received by the government for water powers on the Severn, Wabagoon and Seine rivers.

By the courtesy of the Eugene F. Phillips Electrical Works, Montreal, the ELECTRICAL NEWS has again been honored by an invitation to attend the 20th annual Rhode Island Clam Dinner tendered to the electrical fraternity by Mr. Eugene F. Phillips, general manager of the American Electrical Works, of Providence, R.I. The event takes place on Saturday, September 10th.

On August 15th the ratepayers of Barrie, Ont., by a majority of 170, voted in favor of a by-law to raise $35,000 for the installation of a municipal electric light plant. Tenders for a municipal plant were taken a short time ago, but contracts have not as yet been awarded. The Barrie Electric Light Company claims that the adoption of the by-law means the confiscation of its property, which has cost $80,000.

The Shawinigan Water & Power Company, which purposes to develop Shawinigan Falls, on the St. Maurice river, seventeen miles from Three Rivers, Que., is said to have decided to install a plant capable of developing 100,000 horse power. Messrs. T. Pringle & Son, of Montreal, and W. C. Johnson, of Niagara Falls, N.Y., are consulting engineers for the company, which is composed of Messrs. A. F. Gault, Thomas McDougall, Hon. L. F. Forget, of Montreal, and others.

ERRATA.

IN Mr. Wm. Thompson's article on Corrosive and Scale Forming Agents in Boiler Feed Waters, printed in our August number, the position of illustrations marked 1 and 2 was inadvertently transposed.

ELECTRICIAN WANTED

Applications for the position of Electrician and Engineer, to take charge of Electric Light and Telephone Plant in town of Neepawa, Man. State salary expected, when services are available, and furnish references to J. A. ROBARTS, Secretary-Treasurer, Neepawa, Man.

CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

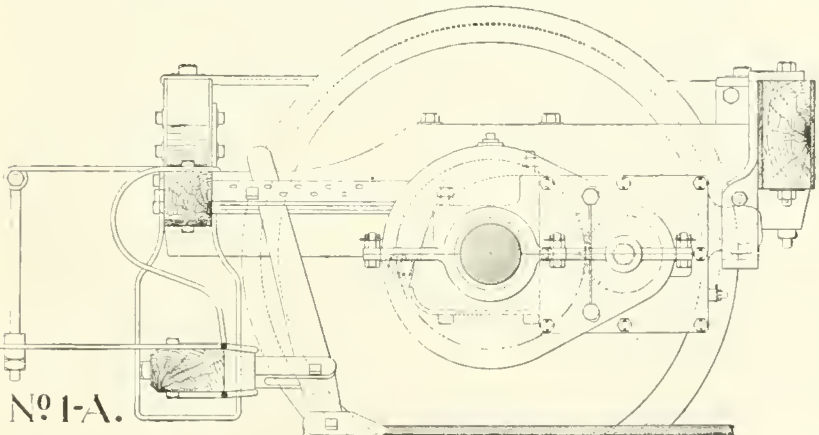
VOL. VIII. OCTOBER, 1898 No. 10.

ELECTRIC LIGHTING OF RAILWAY CARS.

IN European countries the electric system of car lighting has been adopted very largely. Almost all the private railroads of Sweden and Norway have electric light, also many German and Austrian private railroads, as, for instance, the Dortmund Gronau-Enscheder, the provincial railroad of Westphalia, the Altdamm-Colberg, the Marienburg-Mlawka, the Prignitzthal, the Mecklenburg Frederic-William, the Wittenberg-Perleberg, the Arad-Czanad, etc. Many of these have adopted this method of lighting within the past three years. In the United States we also find the system in use to some extent.

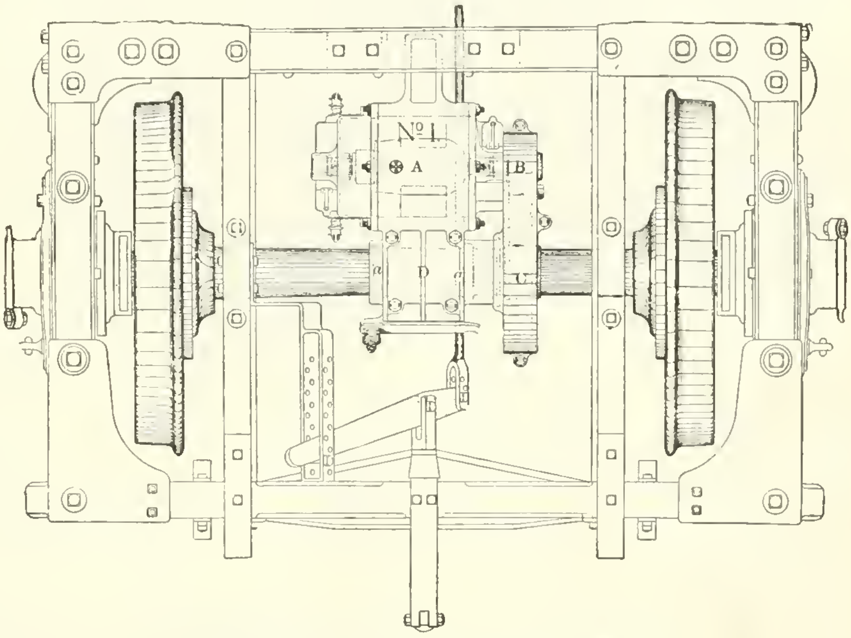
Not to be outdone by other railroads, the directors of the Canadian Pacific Railway have for some time been investigating the various methods of lighting, as a result of which they are now equipping ten sleeping cars with the American Railway Electric Light Company's system, of which illustrations are given herewith.

This system of car lighting consists of a dynamo mounted upon the truck of the car, one end of which is supported by a stirrup from the truck, and the other by the axle. It is driven by a direct gear, which revolves two and one-half times to every revolution of the car wheel. The part resting on the axle rests on a split sleeve. This split sleeve finds its bearings by means of adjustable jaws, so arranged as to take up any irregularity of the axle, and they engage close to the wheels, leaving the central part of the axle free to spring in rounding curves and going over irregularities in the road, and concentrating the weight where it is least felt.



SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

A peculiar feature of this system is the regulating device. This is so arranged that although the speed of the train may reach great extremes of variations, and the dynamo, being directly geared, would normally reach great extremes of current, the current generated by the dynamo is kept substantially uniform during all the variations of speed between twenty miles per hour and the maximum ability of the locomotive. In other words, although the dynamo at a speed of sixty miles per hour is revolving three times as fast as it is at a speed of twenty miles per hour, the amount of current generated is the same.



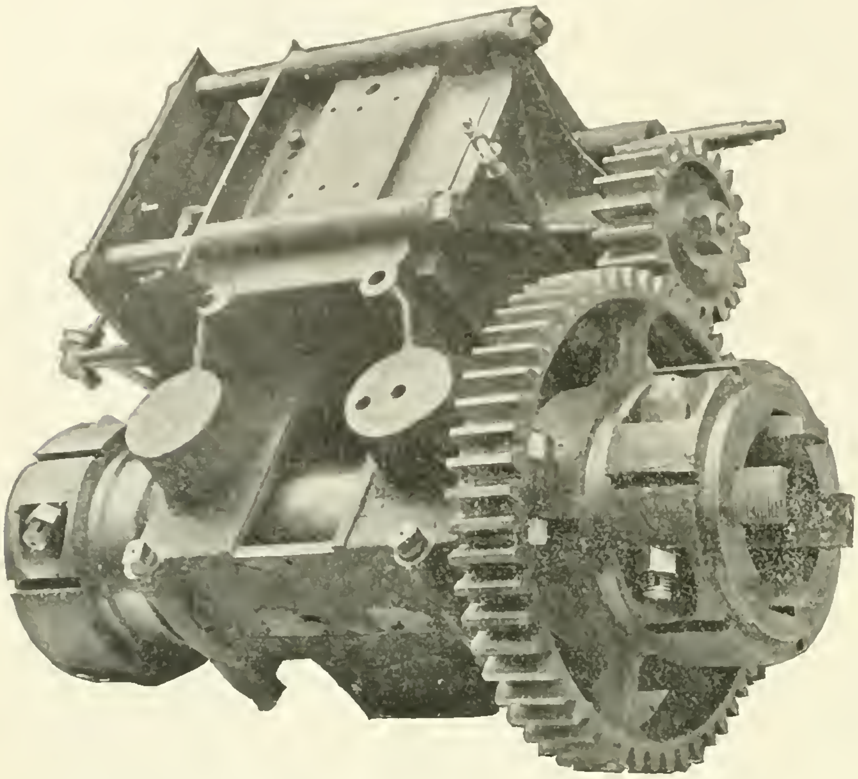
SYSTEM OF ELECTRIC LIGHTING FOR RAILWAY CARS.

In connection with this there is an automatic cut-out, so adjusted as to throw the dynamo into circuit with the lamps upon its reaching a potential equal to that of a small storage battery supply, and throwing it out of circuit upon its dropping below. The effect of this is that when the lamps are burning, and the train running at twenty miles per hour, the lamps are fed directly from the dynamo, and the small surplus of current goes through the batteries. When the speed falls below twenty miles per hour the cut-out works automatically, and as long as it continues at its low rate of speed the lights are drawn direct from the storage batteries, which are capable of supplying the lights independent of the dynamo for from six to twelve hours.

The porter is given no instructions beyond being told to turn the lights on when he wants them, and turn them off when they are no longer required. The system is being installed on the C.P.R. cars by the American Railway Electric Light Co., of New York.

Another feature of this system is, that in running during the daytime, when the batteries are full, the very act of turning off the lights cuts down the efficiency of the dynamo to a point where it generates only the normal current necessary to pass through the batteries in order to keep them in the best of condition.

Should it be desirable, as it very frequently is, to introduce electric fans into the sleeper during the heated months, the current generated by the dynamo would be amply sufficient to keep a large number of them, if required, in operation, while yet serving the batteries with all that they required.

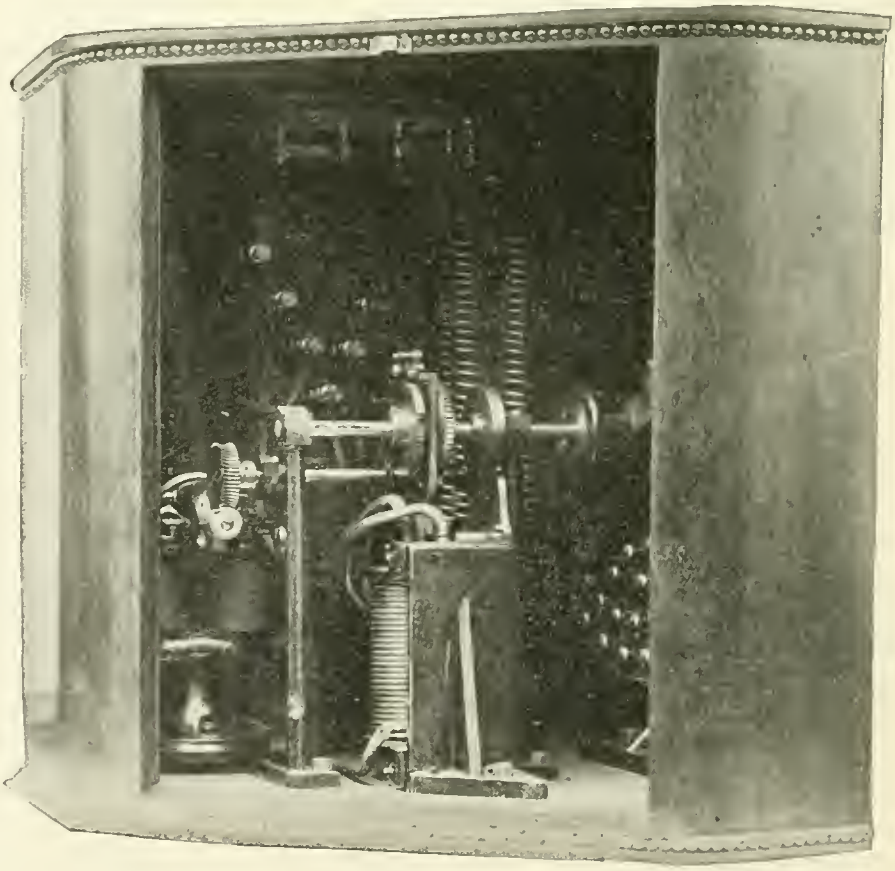


View of Axle Device—System of Electric Lighting for Railway Cars.

An evidence of the improvement in business conditions attending the manufacturing and other interests throughout Canada is markedly indicated by the large number of isolated electric lighting plants being installed this season, and the many increases in the generating capacity for both lighting and power work which are being made in central station plants.

Mr. D. A. Gordon, of Wallaceburg, Ont., who has secured a franchise for the installation of an incandescent electric lighting plant in the town of Tweed, has recently given an order to the Canadian General Electric Company for one of their 500 light single phase alternators. The order also includes the necessary material for the erection of a complete lighting plant.

Mr. T. Ahearn, president, and Mr. J. D. Fraser, secretary-treasurer of the Ottawa Street Railway Company, were in attendance at the annual convention of the American Street Railway Association held in Boston last month. As a result of their observation, the company will adopt a system of book-keeping recommended by a special committee of the association. This system will, it is claimed, secure uniformity in the accounts of all the street railways throughout Canada and the United States, and enable comparisons to be made of expenses in all departments.



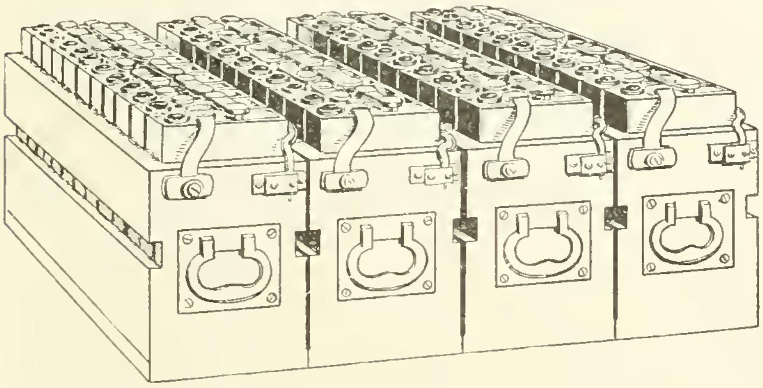
Regulating Device—System of Electric Lighting for Railway Cars.

AN ELECTRIC DELIVERY WAGON.

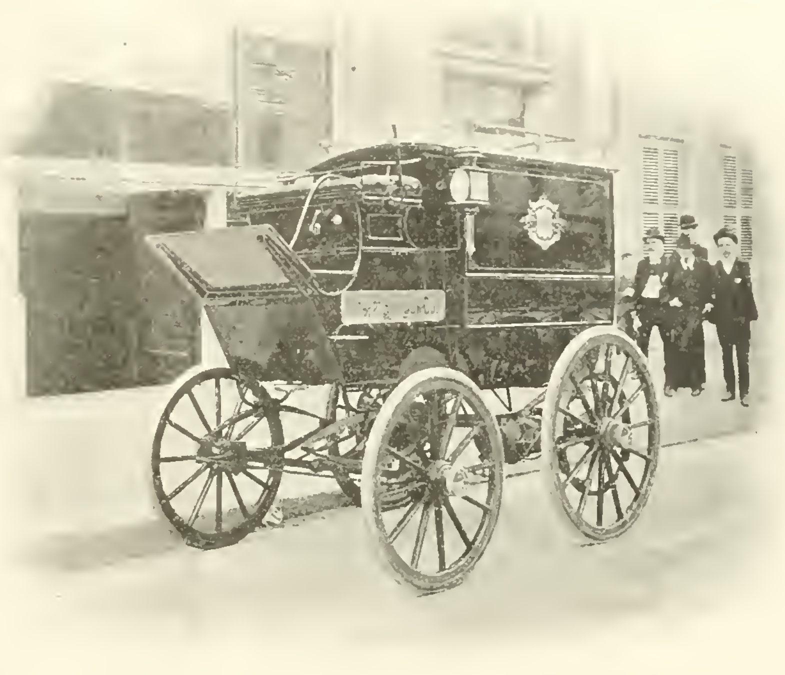
The first electric motor wagon to be used in Canada solely for a commercial purpose was recently added to the delivery equipment of the Robert Simpson Company, Limited, of Toronto, and has been in service for the past six weeks. The vehicle, of which a view is shown on opposite page, was manufactured by the Fischer Equipment Company, of Chicago, and is known as their No. 2 coach delivery wagon, the equipment consisting of forty 120 ampere hour cells of batteries, which operate two 2½ h. p. motors. The motors as applied to the propulsion of this vehicle are independent in their action one from the other, inasmuch as one motor is attached independently to either rear wheel of the vehicle. These motors are four pole machines, with series wound fields and also series wound armatures, on which but two brushes, ninety degrees apart, are used. The windings of the armature itself are what is known as coil wound, that is, coils are wound up on formers and subsequently placed in slots in the armature, the construction of the latter being what is known as the iron wound form, with but one-sixteenth inch clearance between the armature core and the field magnet, the object being to give the greatest torque with the smallest amount possible of field energy. In other words, the air gap being reduced to the smallest possible space, and the magnetic circuit consisting of cast steel in the pole pieces and sheet steel laminated discs in the armature, reduce the amount of field winding to a minimum, and hence its resistance is very low. The commutators are made very large, and current is delivered to them through carbon brushes, which have an area of contact with under under one hundred per cent. over load equal to 40 amperes per square inch of contact surface. The speed of the motor is 1,000 revolutions at 2½ h.p., and is directly geared with a 2½″ pinion to a 26″ driving wheel fastened to the wheel of the wagon, which wheel is 46 inches in diameter, and at a thousand revolutions of the motor gives a speed to the vehicle of a trifle over fourteen miles per hour.

The batteries of the vehicles are arranged in four trays, and the control of the various speeds of the wagon are divided into three; one in which the four trays are in parallel to the motors, giving twenty volts; one in which two each of the four trays are in series and the two series in parallel, giving forty volts; and one, the maximum speed, in which all four of the trays are in series, giving eighty volts. The output of the batteries at the three hour discharge is 27½ amperes for three consecutive hours, and the amperage required of the two motors to operate the vehicles at fourteen miles per hour on a hard level road is 26, that is, thirteen amperes per motor, which gives a three-hour continuous run on a level roadway at fourteen miles per hour—an actual mileage capacity of forty-two miles on one charge of the batteries. The wagon is only rated, however, at twenty-five miles on one charge of the batteries, as high winds, muddy roads, grades, etc., create an extra demand for power which must be provided for; also, the fact must be considered that oftentimes batteries will not be fully charged.

One of the strongest features of the construction of the wagon is claimed to be the brake application, the controller handle and the brake handle being identical and arranged in such a way that the brake cannot be applied without first cutting off the current from the motors, and the current cannot be turned on to the motors without first liberating the brake. This makes it impossible for an inexperienced man to make any mistakes in handling the wagon. The batteries are arranged in trays, as before said, so that they can be divided for control at different speeds, also so that they may be removed from the vehicle for the insertion of duplicate sets, but means are also provided whereby the batteries can be charged in the vehicle, and this is the common way of operating, the current first being cut off from the motors, which is made absolute by the removal of the key after the switch is set in position, and the controller being set upon third speed, which connects all the batteries in series. In this way they are charged directly for 110 volt circuit. The time required for charging under these conditions, when the batteries are fully discharged, is about three hours.

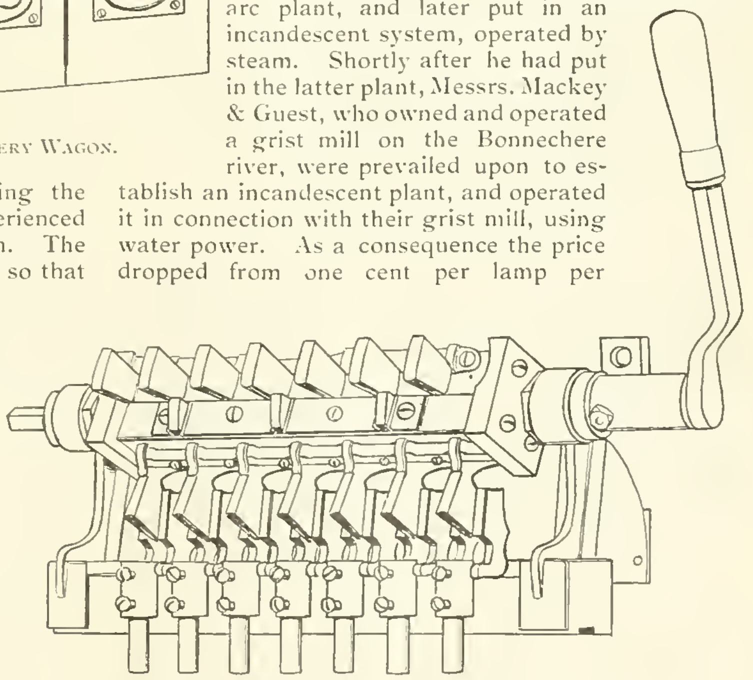

Storage Batteries Used in Electric Delivery Wagon.

From the foregoing it will be seen that by charging the batteries at noon, it is possible to operate the vehicle sixty or seventy miles per day. The motors are mounted on ball bearings, as are also the wheels of the vehicle, and unless specially ordered, the wheels are of regular carriage type set in hard rubber tires. The motor suspension and arrangement of running gear of the wagon is such that no matter how uneven the road is, no strain is brought to bear upon the gears as between the motor and driving wheels, as the front axle is independent in its adjustment to unevenness of the road. The accompanying illustrations were kindly loaned by the owners of the carriage, the Robert Simpson Company.


Electric Delivery Wagon of the Robert Simpson Company, Toronto.

Mr. Jay P. Graves, manager of the Big Three Gold Mining Company, at Rossland, B. C., has just placed an order with the Canadian General Electric Company for a 75 kilowatt synchronous motor. This motor is to be used in the development of their mine at Rossland, and the current for its operation will be derived from the power circuits of the West Kootenay Power and Light Company.

The town of Renfrew, Ont., is now receiving cheap light as the result of competition. Early in the eighties, Mr. A. A. Wright installed an arc plant, and later put in an incandescent system, operated by steam. Shortly after he had put in the latter plant, Messrs. Mackey & Guest, who owned and operated a grist mill on the Bonnechere river, were prevailed upon to establish an incandescent plant, and operated it in connection with their grist mill, using water power. As a consequence the price dropped from one cent per lamp per hour to three-fifths of a cent, at which it still remains Some time ago an attempt was made by the companies to amalgamate, but the negotiations fell through.


Reversible Switch Used in Electric Delivery Wagon.

A new electric light plant will be added to the Frontenac Hotel, Round Island Park, near Kingston.

FIRST CONVENTION OF THE MARITIME ELECTRICAL ASSOCIATION.

The first regular convention of the Maritime Electrical Association was held in the assembly room of the Church of England Institute, Halifax, N.S., on Tuesday, Sept. 27th, 1808, at 10:30 a.m. The following persons were present:

E. L. Nash, Lunenburg; J. Daley, Digby; Fred. A. Bowman, J. H. Winfield, New Glasgow; J. A. Anderson, J. Graham, W. Pickles, F. A. Hamilton, P. R. Colpitt, E. T. Freeman, C. E. Harris, I. H. Smith, J. C. Siebert, J. Christie, Halifax; S. G. Chambers, J. L. McDonald, Truro; J. A. Young, Sydney; W. A. Winfield, Windsor; L. C. Gilling, Bridgewater; J. B. Mortimer, Toronto.

The President, Mr. F. A. Bowman, of New Glasgow, occupied the chair. The minutes of the organization meeting held last April were read and approved, after which the president made a few opening remarks, stating that it had been thought advisable to make the first convention largely of a social nature, as that was the first step towards harmony and strength. The committee of the Halifax members, he stated, had gone to a great deal of trouble in order to provide for the entertainment of the association, but unfortunately the weather had marred the arrangements. It had been arranged to have an excursion by steamer on the harbour, with lunch at Bedford, but this would have to be abandoned owing to the rain.

The secretary-treasurer then read his report, as follows:

At our first meeting held on April 12th, 1898, fifty-six gentlemen handed in their names either personally or by proxy, signifying their intention of becoming members of the association. Since then there have been three members elected, making a total of fifty-nine. The receipts have been: 45 membership fees, $90.00, and the expenditure, for various items, $57.55, leaving a cash balance of $32.45. There are fourteen fees still unpaid. I may be permitted to call attention to the fact that the membership fees already paid in are intended to cover the present association year, which ends 31st March, 1899. We must therefore depend, for the financial requirements of the present year, solely upon the balance in hand, the unpaid fees and the fees of new members who may come in during the year. Thus you will see that there is need for personal effort to extend the membership, and for careful husbanding of resources, in order to finish the year with a balance on the right side.

J. H. Winfield, Secretary.

The president then called the attention of the members to the necessity for an increase in membership, and requested them to use their best endeavors to get others in their respective districts to become members of the association. The majority of the managers of the different companies had already joined, and if they would induce their directors and larger shareholders to take an interest in the work he thought much good might be accomplished.

The president then read his address, as follows:

PRESIDENT'S ADDRESS.

In greeting you at this the first regular convention of the Maritime Electrical Association, it gives me great pleasure to feel that, in meeting here to-day, we have made a great step in advance. We have the honor of being the first section of the Dominion to establish a local organization to work in unision with the central one, the Canadian Electrical Association. As was pointed out in the circular letter issued previous to our organization meeting last April, it was felt that owing to the magnificent distances with which we have to deal in this, our great Dominion of Canada, it was impossible to arouse a very deep interest in the Canadian Electrical Association among the electrical men in these provinces, because it would be impossible for many of them to attend the conventions. It is difficult to get up a warm enthusiasm in an institution the leading men of which you have never met, and may never meet, and the meetings of which you do not hope to be able to attend. Although the benefits to every one belonging to that association would be undoubtedly great, it is hard under these circumstances to get men to see it. They feel as if they were paying their annual fees without receiving an equivalent. It was therefore thought that if an association of a more local character were formed, that would draw together those who are able to go only a comparatively short distance, and if its conventions were held at points accessible to them, they would get to know each other, and also to realize the benefits of such an association, and would then be more ready and willing to give their support to the larger central institution, either by individually becoming members of it, or as a body lending their weight to assist it in any work affecting the industry generally, or in both ways.

When our movement towards organization was announced to the Canadian Electrical Association, we received some very kind words from them. The executive council expressed the hope that means would be found to have the two associations work in unison.

At this our first convention we have not been able to get a very extended list of papers to lay before you, and there is not a very large amount of business to be transacted. The spring and summer is recognized by all workers in technical associations as being the most difficult in which to get papers written. This is naturally so, not only on account of the weather, which is much more conducive to outdoor recreation than to indoor writing, but also because in our business most of us are busy working at extensions and improvements in our outside plant at this time of year, and in preparing for the rush of the fall and early winter's work. On the other hand, the season is well adapted to what must be a very large and important part of the work of our first convention, that is to say, the getting to know each other. Dotted down as we are all over the Maritime provinces, considerable distances apart, comparatively few of us know many of those engaged in the same business, except in the nearest towns. If this first meeting accomplishes no more than to do away with some of this state of affairs, and to send the members home feeling that they know more about their co-workers in these provinces, and that they have picked up some knowledge of other plants, a great and good work will have been done, and a solid foundation laid for future use. The local Halifax members have grasped this idea most strongly, and have gone about its accomplishment in an energetic fashion that will appeal very strongly to our sociability. Being myself from an outside town, I feel at liberty to thank them for their hospitality to us, and, as President, I thank them for their efforts to make our first convention a success. The present time was selected because cheap railway fares are available, and because it was thought that many who would be coming to the exhibition could not make a second trip a month or so one way or the other from it. This renders the efforts of our Halifax members the more laudable, as the present time is distinctly inconvenient to them, owing to the crowds that are in the city. We are gathered here as members of a business which is eminently a creation of and typical of the age, and in this gathering together we are also following the trend of the times.

Centralization and organization are the ruling ideas in every department of work to-day, and in fact almost equally so in our amusements. There is no question that the marvellous progress of the latter part of this century is due almost entirely to this movement. Individual workers could never have accomplished the results that have been attained within the life time of the youngest of us, if they had worked each on his own line without knowledge of what others had done or were doing. The capabilities of the greatest are limited, and each one, if he is to advance himself and his work, must begin where the man before him left off; there must be no time wasted in travelling over the same ground. Experience shows also that to really get the fullest benefit from another man's work, you must not only study him in print, in the abstract as it were, but also in the concrete, in the flesh and blood. Year by year we find the number of conventions and annual meetings steadily increasing in numbers, size and importance. This in itself is a proof that they meet a need, and accomplish good results. It is very easy for those who stay at home and never join in any of these gatherings to say that they are just a fad and a fashion and will die out shortly; that people feel very big to go to a convention and perhaps read a paper, and get their names in print. But hard-headed business men would long ago have ceased to patronize them if they had not seen the practical good that comes from them. Conventions are human institutions, and therefore are a mixture of good and evil, and often do not reach the ideal of the leaders and more earnest minds in them, but nevertheless, I do not believe that there is any person who has ever attended one, unless he is given over to a spirit of absolute cynicism or pessimism, but will admit that he has derived great benefit from it. Each one of us is struggling along in our larger or smaller sphere, meeting our special difficulties as best we can, conquering them after a long struggle, or sometimes being conquered by them, doing what we think is right and best, and always wishing that we knew more or could learn more. We always have a floating wish, more or less strong, according to the amount of self-conceit and self-assertion that we possess, to know how someone else would get out of the difficulty we are in. There is also an idea that possibly the other man may have a better method or a better system than we have. It is this feeling that is at the root of the convention idea. The strong movement of the last few years towards standard methods, not only of manufactures, but also of keeping accounts and making up reports, is the result of the feeling that more good benefit is derived from exchanging figures with your neighbors than by keeping yourself and your affairs secret. From this idea grows a convention, and at it are gathered together a number of men who are all struggling with the same business and therefore often with exactly the same difficulties. Papers are read and discussed, and we get a number of good ideas. The papers are generally on broad, fundamental principles, and were it not for the discussion and the personal opinions and experiences brought out in it, we would not derive as much benefit as if we sat down at home and carefully perused them in our technical journals.

But outside of the convention hall, between the sessions, at the hotel table, on the little excursions that generally take place, in quiet corners of the hotel office, you see little groups of two or three in earnest conversation. It is in those groups that much of the best work of the meeting is done. It is remarkable how even in an assembly of several hundreds, where the majority are necessarily unknown to one another, those whose experiences are somewhat familiar are drawn together. You meet those whom you already know, and are introduced to others, and the conversation of course gravitates towards the lines of work in which you are all interested, and it will not confine itself, as the formal paper is apt to do, to general principles, but goes right down to actual details of work and methods. Presently you find that the other fellow is asking you if you ever had such and such a difficulty, and how you managed it, or how you did a certain piece of work and what it cost you. You lay your heads together and compare notes and exchange figures, and as a result you both find out just where you are making a mistake, or what would have been a better method of going to work. All this, perhaps, sounds very true and trite to you, and you all feel that you knew it before.

What I want to impress upon you as to the great value of conventions may be divided under two heads. Firstly, if you have been working comparatively alone, without anyone near you in the same line of business, there is a great deal of encouragement just to get into such a gathering and have it brought home to you that you are one member of so large and important a business. You see the style of the majority of the men about you, and feel that they are after all not all of so much greater ability than you are yourself, and if they are succeeding there is no reason why you should not ; you hear those few who really do stand head and shoulders above the crowd speaking of the difficulties and problems they have to meet, and you feel that if they have so much trouble with all their foresight, experience and ability to help them, it is not to be wondered at if you get into a hole sometimes. Secondly, you make acquaintances which later ripen into close business and personal friendships, and when the time comes for united action on some point affecting the industry, you know just who is the one to lead and who is to be depended upon.

The feeling about the interchange of information has been steadily gaining ground for many years. In former times the great strength of each man's business was the trade secrets he had that no one else had, and the fact that if he built a machine you had to go to him for every bolt to repair it, because no one else's bolt would fit. To-day it is all different ; everything must be made to a standard, and all parts must be interchangeable. With this progress the trade secret has largely vanished, and information as to processes and method of manufacture is gathered and spread broadcast by technical societies and trade journals.

The vital question back of all this, namely, the cost of production and the methods of keeping accounts, has been the longest to yield to this movement for the dissemination of knowledge. Men seemed to think that while they could afford to tell their neighbor a good deal or all about how they did their work, in order that they might get ideas in return, that they must keep their methods of keeping costs and the costs themselves closely secret ; that if they let their competitors and the public know just what it cost them to do work and what profit they were making, that the knowledge would be used against them. This feeling is now disappearing to a certain extent, and during the last two or three years information has been made public that would hardly have been entrusted personal friends previous to that. Signs of this are all around us. One of the leading engineering periodicals has been publishing series after series of articles on shop cost, and methods of keeping them. In these the methods of accounting the actual costs are given from many of the largest and most successful works in the United States. The fact that so much space in this journal has been given to this subject shows not only that the articles are highly appreciated, but that the heads of these establishments find it to their advantage to give out this information. Another sign is the formation of a committee of the National Electric Light Association to take up the question of a standard system of keeping accounts. And a still stronger move is the formation among the street railway men of a Street Railway Accountants Association, which held its second convention two weeks ago in Boston, simultaneously with the street railway convention. Similar work is being done in the steam railway world. Probably the keen competition and the reduction of prices, and with them of profits, has largely forced on this movement, it being in many cases a matter of good policy if not of actual self-defence to show the public that prices are being forced down to or below the living point, and to break up the idea that nearly everyone has, consciously or unconsciously, that enormous profits are made in every other business except his own.

I would like to say a few words on the matter of the preparation of papers. Every association, except those with the largest and most learned membership, experience considerable difficulty in getting papers for the meetings. Much of this is due to a misunderstanding on the part of the members. They have an idea that a paper must be a learned discourse of considerable length, composed on a subject that no one else has touched upon, or else bringing out some strikingly new or original ideas on some older subject. They think that it must have an oratorical prologue to properly introduce the subject, a lot of mathematical formulæ strewn through it like the currants in a cake, and some illustrations with letters of reference all over them to represent the raisins, and then the whole thing closed up by an eminently logical peroration ; that they must accompany the reading of it by elaborate verbal explanations, and have a blackboard at hand that they must cover with xs, ys and zs, until the audience has been worked up into such a state of bewilderment that it is ready to accept any statement the author likes to make. Now, this is an entirely mistaken notion. The theoretical and mathematical papers have their value, and a very high value it is, and we could not do without them. But we have room and a very large demand for shorter and more practical papers. The large societies and institutes can be depended upon to give us an unlimited supply of the former class, but it is from just such men as we have among our own members that the latter class must come. What we want is short practical papers touching on the difficulties and experiences that we all have in our daily work. The English Institution of Civil Engineers, the leading engineering society in the world, with a membership of over 6000, publishes many very short papers each year, as well as the longer ones, which it, of course, has comparatively little difficulty in obtaining. The short ones, as a rule, come from practical engineers all over the world One man has had some trouble with a bridge pier and he sends in his experience, and a couple of pages of print holds it all. Others have met other small problems and attacked them successfully, and they give their fellow members the benefit of their work Several of the large societies on this side of the Atlantic are doing the same thing and sending to their members each month a number of small papers, many of which cover only one page. A member of one of these societies assured me that he got many very valuable suggestions from them. Some, of course, were not directly in the line of work which he was following, and others contained points that he particularly wanted to know.

I want, therefore, to impress on you all that if asked to present a paper you do not begin to say that you have neither time nor ability, because you have both if you look at the matter in the light in which I have been trying to put it to you. Every one of us has had some experience that it would be useful to others to know of, and every one of us is capable of writing it down in a few plain words so that it can be understood. Do not think that a matter is too small to be worth talking about. If an experience has been of value to you it will be of value to someone else, and that someone else will be glad to get it, and your telling it to him will save him having to work it all out for himself. Even if he has had the same experience he has dealt with it in a different way perhaps, and will say so in the discussion, then each learns from the other and the rest of the association has the experience of you both to draw from. Again, a paper that does not amount to a great deal in itself may start a discussion that will draw out much valuable information. This is a very common experience in technical societies. The discussion often does not follow the lines of the paper at all, but the paper suggests some idea to a listener and he brings it forward and it is taken up by others and the ball set rolling.

So I repeat, if you are asked for a paper do not blush modestly and disclaim the requisite time, knowledge and ability, but stop and think over your work and see if there is not something that will be of value to others to know. Perhaps you spiked and painted a lot of poles and kept account of the material and labor on them. Now, this is a very simple every-day operation in the business, but I will venture to say that a great many of your fellow members would be very glad of some information as to probable cost and quantities. I know I had a good deal of difficulty in procuring it the first time I needed it, and am open to receive much more than I now possess. Again, possibly you have had some difficulty with a dynamo, something that has baffled you for a long time and that you sat up alongside of that machine for nights to try and find, and at last when you did find it, it was so simple you felt half ashamed of yourself for not having discovered it sooner. But do you not think that an account of the trouble with the method you adopted in your search might be just what some one else wanted? Or perhaps you have been successful in your method of lighting some hall, lodge room or church. I will give just one illustration of this. Some two or three years ago some one wrote for a leading electrical journal a short account of a method he had successfully employed in lighting a lodge room for a secret society. The article barely filled a column of the paper. Some time later I was called on for estimates for lighting a new lodge room for such a society. I remembered the article and, referring back to it, used many of the writer's ideas. A fairly vigorous canvass was necessary to get the scheme through in its entirety, and I was greatly aided in it by taking the number of the periodical and pointing out that what I was recommending was what had been found satisfactory elseewhere. I mention this because I believe many would have thought the ideas in that article much too simple and self-evident to be worth publishing I am sure that I voice the sentiments of a large number when I say that I wish more of those simple ideas appeared in our technical journals, and I know they would be willingly published if contributed. I spoke of your being asked to present papers. Do not stop to be drummed up and asked. When you come across something of interest make a note of it and write it out simply and plainly and send it in.

The appreciation of the address was evidenced by hearty applause.

Mr. Hamilton : I feel that we owe thanks to our president for his interesting and able address. There is so much suggested by it that it is hard to deal with it in a fitting manner. The principal suggestion is perhaps that bearing on the preparation of papers. Most of us feel that the writing of a paper is a hard task, but we must feel encouraged by his remarks. While on my feet I would like to say, in reference to this our first meeting, that it is unfortunate that the elements are against us, but the attendance is encouraging, and I trust this will be the foundation of larger and better meetings in the future. Exchange of ideas at first is hard, but as we get to know each other it will become easier. Speaking of the class of papers as mentioned by the president where chasing the wily X is indulged in, they are valuable for reference, but the discussions they invoke are both useful and interesting. I feel that it is not my province to make any further remarks, but again wish to express my appreciation of the president's address.

Mr. P. R. Colpitt : I feel diffident about speaking of papers after Mr. Hamilton, as he has prepared a paper, while I, though invited to contribute one, did not, but I heartily second all his remarks. I beg to move the acceptance of the president's address with the thanks of the meeting.

Mr. Daley: I have much pleasure in seconding that motion.

The motion was put by the secretary and carried.

The president then thanked them for the vote of thanks.

Mr. J. A. Young said he was very glad to have the opportunity of listening to the address. This was the first meeting he had attended, and he thought the suggestion of getting to know each other was a good one. "I am away down in Sydney, and it is hard to get any one to talk to," he said. Referring to the president's remarks regarding poles, he stated that he would probably have to erect eight or nine miles of pole line shortly, and though he had already erected some fifteen or twenty miles, he did not possess all the information he required, and by such meetings as this one could acquire many valuable pointers.

Mr. Daley then brought forward a letter just received from his town council calling upon him to execute a bond of indemnity against any damages the town might be liable for, through his poles and wires being in the streets, and desired to know the experience of other members in this matter.

Some discussion took place, during which it was shown that if a company was possessed of a proper charter this matter was thoroughly provided for without a bond.

Mr. Nash: As this is an experience meeting, I would like to give one. I noticed some time ago that there was a lot of hot air over my boiler, which was serving no useful purpose, and it occurred to me that it would be a good plan to obtain a blower and introduce this air under the grate bars, but my directors failed to see the point. On New Year's day we had a terrible windstorm and our chimney was suddenly reduced in height from 60 to 25 feet. I immediately telegraphed to Boston for a blower. When it arrived I belted it to the engine, ran a pipe to the grate bars, and have been happy ever since. Our income has increased about $300, and the coal consumption remains the same, so that I think the blower has paid for itself. I have figured that the blower has increased my capacity about 10%, and can often get over the peak of the load with one boiler, while before I always had to use two.

The president said he was glad Mr. Nash had brought up this matter, as it was the kind of discussion that was needed. Continuing, he said the question of forced draft had lately been growing in importance. It is a question with most of us, he said, between putting up an iron stack every three or four years or expending a large sum on a brick one. Iron stacks do not last with us as they do in the western provinces, owing to the greater corrosion caused by the dampness of the atmosphere. This was an illustration of the benefit of our local association, as it gave an opportunity to discuss a question that would never have come up in an association holding its meetings farther west.

Mr. Chambers said he hardly expected to speak on the question of forced draught, but he had studied it considerably of late, and thought that some of its advantages were over-rated; nevertheless, he expected to install shortly a blower in his own plant. There was another matter that might be mentioned, viz., that of the automatic stoker. He thought much of the advantage claimed for that was due to the improved draught.

Mr. Freeman stated that Mr. Nash's plant was under a hill and his natural draft was at times poor.

Mr. Nash explained that he had a gate in the outlet which regulated the flow of air, and when the gate was entirely closed the belt of the blower ran very slack, showing that very little power was being used.

Mr. Colpitt said that in a Sturtevant blower, when the outlet was closed, the whole body of air in the blower was in motion and called for comparatively little power to keep it moving, whereas as soon as the valve was opened, and the air in the blower forced out, fresh air entered at the centre and had to be put in motion, calling for an expenditure of energy. In reply to a question of the president, Mr. Nash stated that he used Cape Breton slack coal.

Mr. Daley asked for the experiences of any of the members who were using jet condensers.

Mr. Chambers said that in plants of over 80 horse power and with water cheap, it would pay to install a condenser. His own plant had a capacity of 300 horse power and the saving was enormous, but in 60 or 80 horse power it hardly paid for the trouble and expense of installation.

Mr. Nash: Another question I would like to ask is, what is the advantage of insulation on the conductors of long distance transmission lines at high potential? I am about to utilize a water power and will have a transmission line of some eight or nine miles.

In the discussion that followed attention was drawn to the fact that all the great transmission plants, such as those at Montreal and Niagara Falls, used bare wire exclusively. It seemed to be the unanimous opinion of the members that covering on a wire carrying over 2,000 volts was largely a snare and a delusion.

The president mentioned that Capt. Brophy, of the American underwriters, condemned the use of a covering on high potential wires. After some further discussion it was decided to finish the business at the morning session, doing away with the afternoon meeting, as several of the members were anxious to get away.

The question of time and place of next meeting was then taken up. It was moved by Mr. E. T. Freeman, seconded by Mr. S. G. Chambers, that the next meeting be held at Halifax some time in January. Carried.

The president then introduced Mr. F. A. Hamilton, who read a paper on "Electric Gong Buoys," which is printed elsewhere.

The president remarked that the paper was singularly appropriate for the first meeting of a maritime association. The question of signalling in foggy weather had been very much in evidence in the technical journals during the last few months, owing to the loss of the French liner La Bourgoyne, and other recent accidents at sea.

Mr. Chambers: I have listened with great pleasure to Mr. Hamilton's paper, but I think we all would have enjoyed it more had we been able to have gone from here to the steamer for the excursion as originally proposed, and seen for ourselves the need for such a system of signalling. I have much pleasure in moving a vote of thanks to Mr. Hamilton for his interesting paper.

Mr. Daley seconded the motion, which was carried unanimously.

The president then conveyed the thanks of the meeting to Mr. Hamilton for his able paper.

Mr. Hamilton, in reply, requested permission to read a letter which he had received from Mr. W. H. Preece, of the English post office, in which he expressed his approval of the system, but suggested the use of alternating currents, thus doing away with the use of springs, which would be apt to stick.

Mr. Chambers: Is there a way of producing a noise at a distance by electricity, other than by a bell, that would be suitable for a fire alarm?

Mr. Hamilton: That opens up a wide field. A motor could be used to drive an air compressor which could store the compressed air in a chamber, and thus be utilized to blow a whistle.

Mr. Chambers: That has been tried in the States, but the air leaked out, and when the alarm was wanted it would not work.

Mr. Colpitt thought that the buoy would be too small to contain the mechanism necessary to ring a bell of sufficient size to be heard any distance.

Mr. Hamilton explained that a small bell could be heard a long distance to leeward, and his idea was to get the buoys far enough out so that a vessel could always run to leeward of them without coming in dangerous proximity to the coast. The bell would be placed high up on the mast and the other mechanism low down in the buoy to counterbalance the bell.

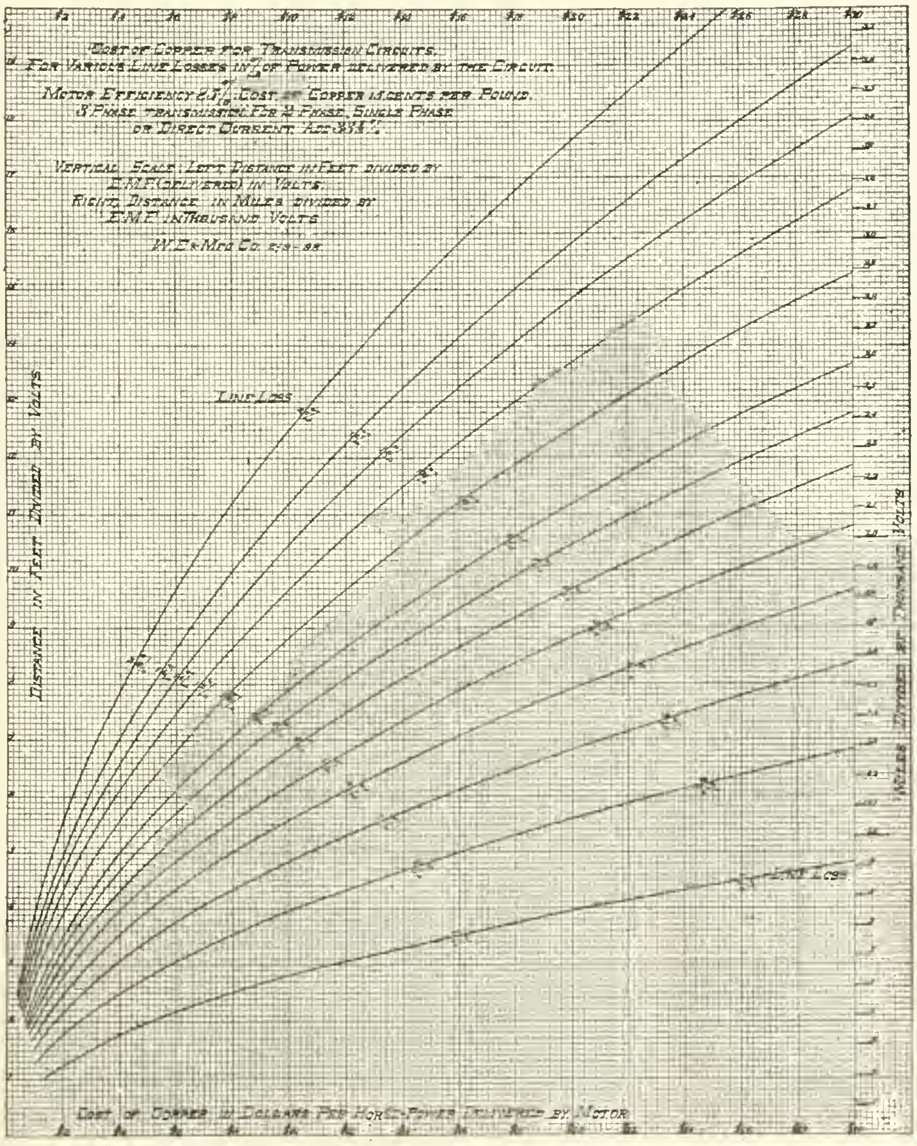
Mr. Daley then moved, seconded by Mr. Anderson, that this convention do now adjourn. Carried.

COST OF COPPER FOR TRANSMISSION CIRCUITS.

The accompanying diagram, showing the cost of copper for transmission circuits, was prepared by Mr. Chas. F. Scott, electrical engineer of the Westinghouse Electric Manufacturing Company, and embodied in a paper on "Electricity in Paper Making," read before the American Paper and Pulp Association. The curves enable one to find the cost of copper for transmission circuits with any given percentage of line loss, the distance in feet or miles, and the voltage, and will no doubt be found useful.

Mr. Scott's paper explained in a brief and simple manner many of the characteristics of electricity and electrical apparatus, and showed in what way and under what conditions they might be profitably employed in the paper-making industry. His conclusions as to the efficiency of electrical apparatus are given in the following words:

"The full load efficiency of generators, both of direct current and alternating current, varies with the size and type, but for machines of 100 horse power and over the variation may be from 90 or 91 per cent. to 95 or 96 per cent. The efficiency of alternating current transformers, in the same way, may be said to vary from 96 or 97 per cent. in sizes less than 100 horse power and 97 or 98 per cent. in larger sizes. The efficiency of motors both for direct current and alternating current varies from 80 or 85 per cent. to 90 per cent. in sizes from 5 to 100 horse power, and is 90 per cent. to 96 per cent. for larger sizes. Efficiency of transmission lines and distributing circuits depends upon the E.M.F., the amount of copper and upon the cost. The approximate efficiency of a transmission plant will therefore be between limits about as follows:



Curves Showing Cost of Copper for Transmission Circuits.

Generators	90 to 96%
Raising transformers	96 " 98 "
Transmission line	90 " 95 "
Lowering transformers	96 " 98 "
Local wiring	97 " 99 "
Motors	85 " 96 "
Efficiency of plant	61 " 83 "

"In local distribution from low voltage generators the losses in raising and lowering transformers are of course eliminated, and the range of efficiency becomes 66 per cent. to 86 per cent."

THE BULLIER CALCIUM CARBIDE PATENT CANCELLED.

The Berlin Patent Amt has nullified Bullier's calcium carbide patent, and in view of the constantly growing importance of acetylene, it is worth while to review the facts of the case. Bullier was Moissan's special demonstrator, and the patent was granted in 1894 for the only practical process of producing calcium carbide in the electric furnace. This German patent of the French chemist becomes the property of the Neuhausen Aluminium Company, and as they made difficulties over granting licenses it was a stumbling block in the way of the development of the acetylene industry in Germany. Hence, now that it is swept out of the way, carbide will quickly become cheap in the fatherland. As a matter of fact, it is astonishing that the German patent was ever granted, or that the Frenchman Bullier should have claimed the invention. Wilson, an American, obtained English and American patents in 1893 for the production of calcium carbide exactly in the same manner, and even his patents were not now unassailable, seeing that a German chemist, Professor Borchers, had made the first communication of the method of producing calcium carbide ten years before. The German Patent Amt accorded the patent to Bullier for crystallized carbide, but Lord Kelvin affirms that the calcium carbide sent to him by Wilson in 1892 was in perfect crystals.—Invention.

"I find The News very interesting and instructive, and I don't intend to be without it."—Mr. H. Large, Guelph, Ont.

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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Short-Sighted Methods.

FROM information to hand, we are of the opinion that the movement in favor of municipal control of electric lighting is being advanced by the unpopular methods of some of the private lighting companies. In quite a number of instances these companies have not pursued a business policy calculated to satisfy their customers and enable them to retain their business. They have acted on the principle, and, in fact, have in some instances been foolish enough to assert, that the customers must take light under whatever conditions and terms the company might see fit to impose. Such companies have not attempted to keep their plant in an up-to-date condition, but have endeavored to run their business with as little outlay for apparatus and operating expenses as possible. As might easily have been foreseen, the result of this line of policy has been forfeit of the sympathy and good-will of the consumers on whom the success of the business must depend, and the dissatisfaction thus engendered has, in many instances, taken the form of active opposition and advocacy of municipal control. Electric lighting companies must recognize the fact that they are in identically the same position as the proprietors of stores and other enterprises which depend for their success on the extent to which they cater to public requirements, and they must not seek to avoid any reasonable amount of trouble to give satisfactory service to their customers. Their object should be to please by every means the persons from whom their business derives its revenue. It will be found to be good policy for the manager of the company to frequently drop in on his customers and learn whether they have any complaints to make regarding the character of the service.

Specifications for Electric Plants.

AT the present time, when several municipalities are considering the advisability of installing electric light plants, the question of having proper specifications on which to tender is one of much importance to manufacturers of electrical apparatus. It is, of course, preferable to have specifications prepared by a competent and unbiased electrical engineer, in order that all tenderers may be placed on the same footing, and that the municipality may obtain the best apparatus for the money invested. But where such an engineer is not employed, it becomes the duty of the official deputed to draw up the specifications to obtain as much information as possible on the subject. As our readers know, the city of London, Ont., recently invited tenders for an arc plant, upon specifications prepared by the city engineer. Exception was taken to these specifications by at least one company, on the ground that they were such as to exclude some manufacturers of electrical apparatus from tendering. While in some respects the specifications could have been amended with advantage, we are of the opinion that on the whole they gave quite general satisfaction, as will be seen by reference to a number of letters from interested persons, printed elsewhere in this issue. These letters will, we believe, serve a useful purpose, inasmuch as they show the prevailing opinion with regard to the conditions which should be embodied in specifications of this character. It is regarded as a mistake, so far as the purchaser is concerned, to place such restrictions on tenderers as will shut out good apparatus and limit the field for competition. A greater error is to specify a certain make of apparatus, thus permitting the manufacturer of same to fix his own price for the goods. This was the mistake, and about the only serious one, committed by the city engineer of London. By specifying the Adams-Bagnell single carbon lamp, he excluded the manufacturers of all other lamps from tendering, and gave the Adams-Bagnell people the contract at any price they wished to name.

Canadian Materials.

ALTHOUGH it is only a few years since the first electric railway was built in Canada, it is now possible to obtain in this country all the materials necessary for the complete equipment of an electric road. In the case of the street railway recently completed at St. Thomas, Ont., we observe with pleasure that, with the exception of the overhead joists and fixtures, the line was built and equipped with Canadian material, the total cost being $85,000. The rails were made at Hamilton, Ont.; the engines at Amherst, N. S.; dynamos and electrical equipment at Peterboro', Ont., and the cars at Ottawa. We would gladly welcome more examples of this character, as upon the building up of our industries depends the future of the Dominion of Canada.

The Maritime Electrical Association.

THE Maritime Electrical Association is to be congratulated, as a new organization, upon the steps which have been taken to establish the foundation of a useful society. It is true that unless other than social advantages are to result from the formation of such associations, their existence is likely to be of short duration. This is fully recognized by the members of the Maritime Electrical Association, the proceedings of the first meeting of which are printed in this issue. Associations of this character permit of the discussion of questions having a local bearing which, even if taken up by a Dominion association, would interest but a comparatively small percentage of the members. In Canada, perhaps more than in other countries, owing to its vast territory, there exists the necessity for local organizations, and we therefore predict a reasonable measure of success for the association in question. We have no fear that the interests of the Canadian Electrical Association will be likely to suffer as the result of the formation of local organizations of this character; on the contrary, they should be a source of strength to the more important body. In the presidential address of Mr. Bowman are found many suggestions by which the members should profit. The practical experiences related by the members are likewise instructive. May the association extend in membership and usefulness.

Penny Wise and Pound Foolish.

SOME of the electrical companies are pursuing a "penny wise and pound foolish" policy with regard to the efficient operation of their plant. It would seem to require but little argument to show that machinery which has cost many thousands of dollars should not be entrusted to the care of an incompetent operative, yet we find managers of companies seeking to save money by cutting down the wages of operatives to a point which must result in bringing them only the services of incompetent men. An instance of this kind came to our notice recently, in which the owners of an electric light plant were compelled to replace two 100 horse power boilers and a 75 horse power engine, which had been rendered useless by lack of knowledge and carelessness on the part of the engineer in charge. The boilers, which had only been a short time in use, had rarely, if ever, been cleaned, and contained deposits of mud which resulted in the shell being burned and the boilers rendered unsafe. A high speed engine had been racked to pieces and the usefulness of a more valuable one so impaired as to render it unfit for the required service. After all this damage had been done and a loss of many thousands of dollars incurred, the manager of the company began to look around for a competent engineer. When told that he would have to pay at least $65 per month for an efficient man he said, "Why, that is $30 per month more than we have been accustomed to pay." Notwithstanding, he at last came to a realization of the fact that to double the engineer's salary might, after all, be the means of affecting a saving in operating expenses, and it is the purpose with the new machinery to install a man competent to properly operate and care for it.

Steam vs. Electric Railways.

IT is admitted by the management of steam railways that great inroads are being made upon their local passenger business by electric railways. The latter are steadily spreading out, and it is difficult to say to what extent they will become competitors to long distance roads. The fact is recognized that there are obstacles to be overcome in connection with the economical operation of electric railways in rural municipalities. In ten years up to and including 1893, the number of passengers carried on the steam railroads in the state of Massachusetts increased at the rate of 5,825,000 a year. The next four years they decreased at the rate of 4,766,000 a year, owing to competition from electric roads, as in these same four years the number of passengers carried by electric railways that enter Boston increased over 31 per cent. The experience of railroads in the vicinity of Chicago and other cities is identical in this particular. If steam railroads are to compete successfully with electric systems, it will be necessary to give cheaper fares and greater attention to the comfort of passengers. Uncleanliness is one of the greatest objections that can be urged against the steam road. But it is not alone the passenger traffic that has been and will be affected. The electric roads are now reaching out, with some success, for freight business. In this connection we observe that a successful test of the Bonner rail wagon, as described in a paper by Mr. W. T. Bonner, read at the last convention of the Canadian Electrical Association, was made recently at Toledo, Ohio. The purpose of this wagon is to convey farm produce to market, its construction being such as to permit of the wagon being separated from the truck and transported on the electric railway to point of destination. Should this scheme work out satisfactorily, as some believe it is likely to do, the field for the electric railway will be greatly broadened.

The amalgamation has taken place since our last issue of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., and the Walker Company, of Cleveland, Ohio, two of the leading electrical concerns in the United States. This is regarded as one of the most important transactions that has been recorded for some time, inasmuch as, besides making a particularly strong combination, it puts an end to litigation affecting Walker apparatus. By the change the Walker Company is brought under the terms of the agreement which has existed for two and one-half years between the General Electric and Westinghouse companies. In a few years the Walker Company have built up an extensive business, and we are glad to learn that their factories are to be continued.

AN ALTERNATING CYCLE-CURVE RECORDER.

By Prof. H. L. Callendar, M.A., F.R.S.

The study of alternating current phenomena by means of the delineation of the curves, which represent the mode of variation of the pressure and current throughout the cycle, has been rendered so familiar by the labors of Hopkinson, Ryan, Fleming, and many other observers, that no apology is needed for introducing a new piece of apparatus intended to reduce the labor involved in this method of investigation. Briefly stated, the function of the Cycle-Curve Recorder is to describe automatically, without any interference on the part of the observer, a continuous pen and ink curve representing the cyclical variation of the quantity to be recorded. The immediate object of its construction was the study of the variations of the form of the current or pressure cycle-curves of a particular form of alternator with variations in the character of the load on the station at different times in the day. The labor involved in this study by any of the usual means was such as to be prohibitive. The action of the present apparatus, however, is so completely automatic that it can be set to record the form of the cycle-curve every half hour throughout the day, and may then be locked up and left to itself, to continue recording for so long a period as may be desired. The complete carrying out of this programme was unfortunately interrupted by my appointment to to the chair of physics at University College, London, and it is now unlikely that I shall have leisure to pursue the investigation myself; sufficient, however, has already been accomplished to show that the apparatus is capable of very accurate work, and is likely to prove a labor-saving device of considerable utility.

The apparatus consists essentially of a recording potentiometer working in conjuction with a cycle contact maker, which selects the P. D. to be recorded from a particular point of the cycle in the usual manner. By means of a simple worm gearing, the contact brushes are slowly revolved, and the point of the cycle selected is continuously varied concurrently with the motion of the record sheet, so that the variations of the P.D. throughout the cycle are recorded in the form of a continuous curve. The recording pen is of the usual pattern, and is directly attached to the sliding contact of a delicate relay on the potentiometer bridge wire. This relay is made to actuate a pair of motors in such a manner as to keep the sliding contact always at the balance point. The drum on which the record sheet is wound may be of the ordinary kind, revolving once in an hour, but if continuous records of the forms of the cycle are required, extending over a longer period without changing the sheet, it is necessary to replace the simple drum by a continuous band. The width of the sheet, which limits the scale of the record, has hitherto been about 8 inches, which is found to give a sufficiently open scale for most practical purposes.

The Recording Potentiometer. The recording potentiometer was not originally designed for this particular purpose. I had, as a matter of fact, previously applied it to a great variety of other uses, such as the recording of variations of voltage, current, power, resistance, temperature, pressure, etc. The idea of making a potentiometer or Wheatstone bridge record its balance point automatically, in the manner described, is a very obvious one. I first endeavored to carry it into practice when working with platinum thermometers at the Cavendish laboratory in 1886. With this object I selected the most delicate polarized relay that I could find in the apparatus room, and connected it up in the place of the galvanometer in my apparatus. I very soon found that in order to record temperatures successfully to the tenth of a degree, I should require a relay about a thousand times more delicate than the best of the post office pattern. After making several other experimental relays with selenium cells, etc., I gave up the attempt for the time, and did not return to the subject till the conclusion of the McGill College session in April, 1897. I then succeeded in constructing a sufficiently delicate relay, and in obtaining records of temperature in pen and ink, on a scale as large as 1 cm. to the degree Fahrenheit. Several of these early temperature and volt records were exhibited at the meeting of the Canadian Royal Society on June 23rd, 1897, and some of them have been reproduced in the Canadian Royal Transactions for that date. The apparatus itself has been recently exhibited at the conversazione of the Royal Society in London, and on other occasions in Canada, where the first instruments were constructed. It is hoped that an improved pattern, as made by the Instrument Co., Cambridge, may be exhibited at the forthcoming meeting of the British Association at Bristol, and that a description of the final form may then be published. In the meantime it may be of interest to describe the cycle contact-maker, and to give some account of the special difficulties which were encountered in connection with this particular application of the recorder.

The Cycle Contact-Maker. The idea of applying the instrument in conjunction with a suitable cycle contact-maker for the recording of cycle curves automatically, first occurred to me in connection with the investigation of the form of steam temperature cycles in the cylinder of a steam engine by means of a very sensitive platinum thermometer, as described in a paper by Prof. Nicolson and myself, "On the Law of Condensation of Steam," which was read and discussed at a meeting of the Institution of Civil Engineers in November, 1897, and has since been published in their Proceedings, Vol. CXXXI. The application to alternating current cycles followed as a matter of course, being, in fact, very much the simpler application of the two. The method of obtaining a continuous record by means of a continuous motion of the cyclical contact point in unision with the record sheet or plate, was employed by Blondel (The Electrician, Vol. XXVII, p. 603), who made use of a spot of light reflected from a dead-beat galvanometer on to a slowly moving photographic plate, the deflection of the galvanometer being proportional to the instantaneous value of the P.D. or current to be recorded. The objection to the method above sketched, apart from the fact that it gives a photographic and not a pen and ink record, is principally that it is a deflection method and not a null method. In the present instance, in addition to the usual objections to a deflection method, there is the difficulty of the variable resistance of the cycle contact in the galvanometer circuit. In the null method, with the potentiometer, changes in the contact resistance are immaterial, and there are no errors introduced by inequality of scale, or hysteresis of the suspension.

The Synchronous Motor.—When completing the equipment of the McDonald Physics Building in 1893, for the application of the cycle-curve method to the study of alternating current phenomena, I ordered a small laboratory alternator of the Pyke and Harris pattern, mounted on a bed-plate with a suitable continuous current motor. My reason for choosing this particular type of machine, with its overhung spider carrying the revolving keepers, was that it could be fitted with a cycle contact in a very simple manner, and could be used, either as a generator or as a synchronous motor, for delineating cycle curves of larger generators. The cycle contact brushes consisted of a pair of fine steel springs mounted side by side on a short projecting arm carried by a divided circle centred on the circular face of the field magnet, which was concentric with the shaft. The ends of the springs rested on the edge of an ebonite disc turned in position on the shaft, into the circumference of which were fitted, at intervals of a complete period, a number of narrow contact pieces of steel, each about one-hundreth of a cycle in width. This form of contact was found to wear very well and to give excellent results, provided that the disc was clean and running perfectly true. The performance of the contact was tested by taking curves, first by the potentiometer balance method, and then by the deflection method under the same conditions. In the second case, any variation in the contact resistance would be made evident by an unsteadiness of the galvanometer. The results compared very favorably so long as the resistance of the galvanometer was made as high as possible, but even in this case it was obvious that the potentiometer method was greatly to be preferred. I, therefore, abandoned the attempt to fit up an automatic recording apparatus of the Blondel type, as I had at first intended, and did not return to the question of obtaining automatic records, until the completion of the recording potentiometer at a later date appeared to offer a more convenient and accurate solution of the problem.

On making the first experiments with the recording potentiometer, I found, as I had anticipated, that the resistance of the cyclical contact was a matter of considerable importance. In order to secure the maximum sensitiveness for small differences of potential, it was necessary to make the resistance of the relay or galvanometer of the order of 10 ohms. Under these circumstances it was evident that any imperfection of the contact, although it would have no effect on the position of the balance point on the potentiometer bridge-wire directly, would reduce the sensitiveness of the relay, and thus make the position of the pen lag behind the correct reading, owing to want of quickness in following. With the object of reducing the resistance of the contact, the width of the strips in the circumference of the ebonite disc was increased, and they were made to project slightly and slope back at an angle with the edge of the disc, so as to maintain the contact as long as possible. It was found, however, that with the 9 in. contact disc originally fitted on this machine, the peripheral velocity was too great for this form of contact, and the brushes had a tendency to jump and break, especially at high speeds. To get over the difficulty of the peripheral velocity, without abandoning the steel spring contact, a small fan motor of a common type was fitted with a synchronising rotor, and an ebonite contact disc of 1 in. diameter. This was fitted with an oil pad to keep the contact clean, and gave very fair results up to speeds of 60 or 80 cycles per second. It would no doubt be possible to make some better form of contact for the purpose, but, as the small motor worked fairly well, and the time at my disposal was limited, I did not think it worth while to make any more experiments in this direction at the time.

The drum on which the record was taken in the potentiometer was made to revolve once an hour by means of an ordinary clock contained in the barrel. The simultaneous revolution of the contact brushes might have been very simply secured by means of a similar clock. But in order to secure sufficient power, and to avoid any possibility of slipping, it seemed preferable to obtain the motion from the spindle of the motor itself by means of worm gearing. It might appear at first sight that this would lead to a certain loss of accuracy, as the interval on the drum corresponding to the wave length of the cycle would vary with the speed of the motor. In reality, however, the accuracy of the record is, in any case, limited by the constancy of speed and voltage of the generator. The contact springs were mounted on an ebonite arm on the face of a worm wheel capable of turning freely on a boss concentric with the shaft of the motor. The tangent worm was driven by another worm wheel, the worm of which was driven by a large pulley belted with an India rubber band to a small pulley on the shaft. Each of the worm wheels had 100 teeth, and the ratio of reduction could be varied by varying the ratio of the pulleys. In the records here reproduced, the speed of revolution of the contact springs was adjusted to be about 20 min. to the half wave, as this happened to give the best proportions to the curve with the drum revolving once an hour, and a scale of 1 in. to 50 volts on the record. The small synchronous motor, fitted in this manner with a slowly-revolving cycle contact, was complete in itself, and proved to be extremely convenient and portable, the whole weighing only 10 or 15 lbs. It was generally brought up to speed when starting by means of a small direct-current motor, but a hand wheel and belt would probably be in many cases more convenient. Such faults as it was found to possess were not inherent in the method or design, but were due to the cheapness of the machine and the roughness of the workmanship. The poles and clearance were unsymmetrical, the rotor badly balanced, and there was too much friction and slack in the bearings and brushes, faults which might naturally be expected in a cheap commercial motor hastily adapted, but which could be easily remedied in making a special instrument for the purpose. The curves here reproduced, which were taken with the first rough experimental apparatus, must not, therefore, be regarded as a fair test of the capabilities of the method. And when we consider that the curves, in addition to the mechanical defects of the motor, include all the variations of speed and voltage of the supply company, it seems likely that the accuracy of the apparatus under favorable conditions will be limited only by the scale of the record, and the fineness of the line traced by the pen. The current cycle curve of the small motor itself is much the most irregular. This might naturally be expected, and is probably to be explained by variation of the friction, which would necessitate variation in the torque and in the angle of lag of the rotor. The majority of the irregularities are, however, too small to show clearly when reduced to half the original scale. This is very creditable to the steadiness of the voltage and speed of the Royal Electric Supply Company.

Description of the Curves.—The first pair of curves are of a familiar type, representing the volt and current cycles on the primary of a 5 h.p. transformer with a closed magnetic circuit, when working at a very low magnetic induction with no load on the secondary. The experimental transformer was not connected directly to the primary mains of the Royal Electric Co., but to the 100 volt side of the lighting circuit transformer, which was otherwise unloaded. The volt and current cycles were not taken simultaneously, but on successive days. The correct relative lag of the current curve is readily obtained on the record sheet, by setting the worm wheel carrying the contact springs at the zero mark, and putting the worm in gear at the moment when the pen reaches the zero line on the drum. The scale of amperes is placed on the right of the figure in each case corresponding to the ampere curve marked (a); the scale of volts is placed on the left and corresponds to the curve of volts marked (v). The scale of the bridgewire was adjusted in the present case to be 2 in. to the volt. The current to be delineated was passed through a non-inductive resistance of one ohm, so that the scale of the record was 2 in. to the ampere. For the volt curve, one-hundredth part of the voltage was taken by means of a ratio box. The scale was, therefore, 2 in. to 100 volts. The horizontal time scale in each case simply marks the speed of revolution of the record sheet on the drum. The length of a wave on this scale depends on the time required by the contact springs to turn through the interval corresponding to a cycle. This was determined by the speed of the motor, and by the ratio of the reducing gear. It would not have been difficult either to drive the recording drum from the motor, or to drive the contact springs by clockwork, in both of which cases the wave length on the record would have been constant. It would probably be more interesting, however, at least in view of the possibility of taking all day records in this manner, to have the variations of speed recorded by the variations of wave-length. The forms of the curves given in Fig. 1 were verified indirectly by comparison with curves taken off the same transformer under conditions as nearly similar as possible, by the potentiometer method, with a sensitive galvanometer in place of the relay and automatic recorder, and using the Pyke and Harris alternator as a synchronous motor. They were also verified by describing the hysteresis loop in each case, and comparing it with the results of ballistic tests. It was apparent that the results given by the automatic recorder were at least as accurate as those obtained by the much more laborious method of eye observations and subsequent plotting.

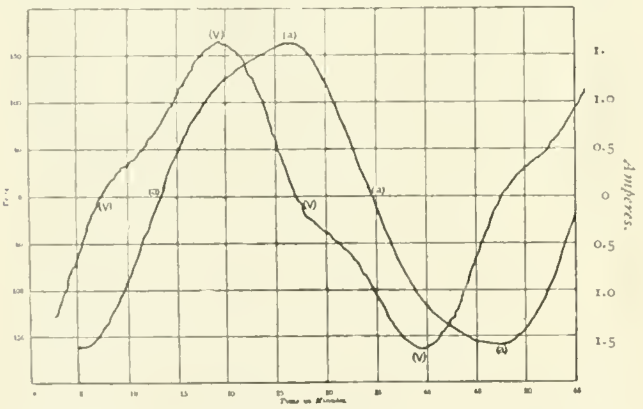

FIG. 1. (a) Automatic Record of Current Cycle, on Primary of Unloaded Transformer. (V) Automatic Record of Volt-Cycle of Stanley Alternators of the Royal Electric Co., Montreal. Taken by Synchronous Motor at the McDonald Physics Building, one mile distant. Speed, 65 Cycles per Second.

The pair of curves exhibited in Fig. 2 were taken on the same record sheet about the same time of day. The volt curve is practically a repetition of the previous volt curve. At other times in the day, under different conditions of load on the supply station, the form of this curve was found to be considerably modified. The inequalities of the curve, which are seen to be most conspicuous near the vertex of the wave, were in all probability chiefly due to variations of speed and voltage at the station. The current curve in Fig. 2 is the current curve of the small synchronous motor itself, and was located on the record sheet, as previously explained, as nearly as possible, in its true phase-relation to the volt curve. The load on the motor was largely due to eddy currents and hysteresis, in addition to mechanical friction. The mechanical friction was certainly variable, and the load due to eddy currents would diminish as the motor became heated. The curve shows a curious want of symmetry, which is no doubt partly to be explained by these causes, and partly by the want of symmetry of the construction of the motor itself. The dip in the crest of each wave is due to an unsymmetrical slot in each of the poles of the motor. These slots were occupied, in its original state, as a synchronous induction motor, by copper plates, partially shading the poles, the function of which was to give sufficient starting torque to the squirrel-cage armature, when used as a fan motor. The other irregularities of the curve are such as might naturally have been expected under the conditions described. The curve itself is of no value except as an illustration of the performance of the recorder. It is quite possible, however, that a study of similar curves, obtained from motors under different conditions of load and supply, might give valuable information with regard to the best conditions of working and the best methods of construction.

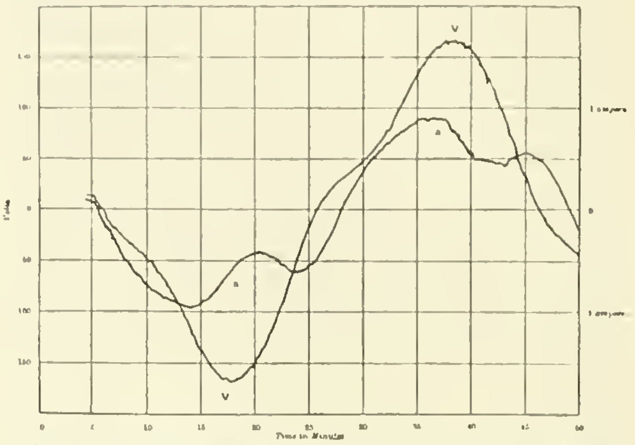

FIG. 2. Automatic Record of Volt and Current Cycles on small Synchronous Motor with Unsymmetrical Slot in Pole Pieces. The minute irregularities of curve are due to variations of speed and voltage of supply. Connected to the mains of the Royal Electric Co. Record taken at the McDonald Physics Building, McGill College, Montreal.

The pair of curves exhibited in Fig. 3 are not cycle curves, but are given as an illustration of the sensitiveness of the recorder and of the different uses to which the same instrument may be put. The change from one kind of record to the other is effected by changing the scale of the bridge-wire, by substituting a different wire and unplugging suitable resistance coils. In the curve Fig. 3 (a), representing the discharge of a small storage cell through a constant resistance, the scale of P.D. on the bridge-wire of the recorder was only 1 millivolt per inch, the record being intended as a test of the delicacy of the instrument. The P.D. to be recorded was taken from the potential terminals of a standard resistance of one-thousandth of an ohm, through which the current was passed. The scale of the record was therefore 1 in. to the ampere. The resistance of the bridge-wire had been adjusted to be one-twentieth of an ohm per inch by means of a suitable shunt, and the current through it was adjusted to be 20 milliamperes by means of an adjustable resistance and a standard cell. The smoothness and steadiness of the record obtained under these conditions were very satisfactory, considering that the power expended on the shunt was only one-fortieth of a watt, at a current of 5 amperes. As compared with the more common types of recording ammeters it will be observed that the resistance of the shunt required is extremely low. The scale, moreover, is exactly one of equal parts, and the co-ordinates of the record are rectangular, as the pen is moved along a straight slide instead of describing a circular arc. The same recording instrument and scale can also be used for any range, from 20 milliamperes to 20,000 amperes, by connecting it to different shunts of suitable magnitude in each case.

The record shown in Fig. 3 (b) affords an even more severe test of the capabilities of the recorder. The current for the bridge wire in this case was taken off the power circuit, and was adjusted to be 30 milliamperes at 550 volts, so that the scale of the bridge-wire was 2 in. to three millivolts. The P.D. to be recorded was taken off a low resistance shunt in the circuit of the large 1,500 kilowatt generator of the Montreal Street Railway. The shunt was one of very low resistance, so that the P.D. to be recorded on the bridge-wire was only 3.30 millivolts for a circuit of 1,000 amperes through the shunt. The scale of the bridge-wire being 1 in. to 1.5 millivolts at 550 volts, and being made to vary directly as the volts, the record was obtained in watts, on a scale of 250 kilowatts to the inch. The P.D. on the bridge-wire in this case was slightly larger than in the previous instance, but the performance of the instrument was in reality more remarkable, because it was hanging on the wall of the power house, in close proximity to the large machines and engines, and was exposed to a great deal of vibration and other disturbance. The record itself presents some features of interest which may be briefly referred to. The large engine (No. 7) was started a little before 4 p.m., so as to be in time for the evening load, which reaches a maximum between 6 and 7 p.m. A load of about 1,000 amperes was switched on, and gradually increased to over 2,000 in the course of the next 10 minutes. Other engines were started in a similar manner about 5:10 and 5:45, as the main load increased. The starting of these engines had the effect of diminishing the load on the big generator temporarily, as shown on the record. Between 6 and 7 p.m. four engines of 1,000 h.p. each were running, in addition to the big engine. One of these was shut down at 7 p.m., causing a temporary increase in the load on No. 7. About 7:30 p.m. the load on No. 7 was gradually reduced to 1,000 amperes, and it was cut out of circuit at 7:45 p.m., after which the reading of the record rapidly falls to 0. In power records of this kind, where the load is rapidly varying 10 or 20 per cent. up and down from second to second, it is necessary, in order to obtain a clear and legible curve, that the recording pen should automatically average these rapid fluctuations, a result which is readily secured with the present instrument by suitably limiting the rate at which the pen can follow a sudden change of load.

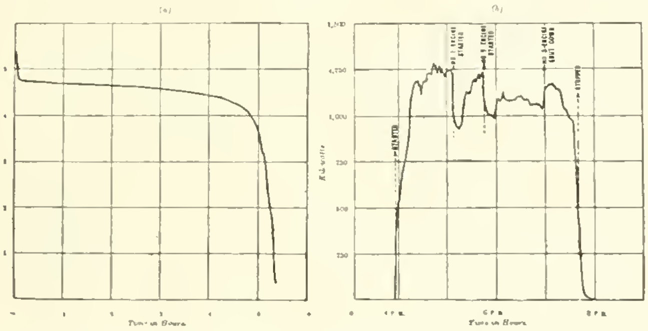

FIG. 3.—(a) Discharge Curve of a Small Storage Cell. (b) Record of Load on 1,500 Kilowatt Generator of the Montreal Street Railway Co., taken at the Power House. Note changes of load due to starting and stopping other engines. These two curves were taken on the same instrument, changing only the shunt.

The foregoing illustrations do not by any means exhaust the possible limits of delicacy of the recording apparatus. It would be easy to make the relay much more sensitive, if required for special work. The present pattern is very simple, and is quite delicate enough for all ordinary purposes. For obtaining cycle records it is evidently impossible to work with so small a P.D. on the bridge-wire, as the galvanometer circuit is closed for a small fraction only of each cycle. For this reason a special bridge-wire was constructed of insulated wire wound in a fine screw thread on a brass rod in a manner similar to that commonly employed in rheostats for fine adjustments. The method of winding in a screw thread gives great regularity and uniformity almost equal to that of the plain wire. Brass is far preferable to hard rubber for accurate work, and there is no difficulty in obtaining sufficiently perfect insulation. The objection to the spiral is that the contact is not quite continuous, but in the present instance, the steps on the record due to the fine screw thread were much smaller than the irregularities due to variation in speed and voltage of the supply. For finer work, however, it might no doubt be preferable to use a straight continuous wire in conjunction with a more delicate form of relay.

The cycle records above reproduced were taken on one of my recording instruments by Mr. L. W. Gill, B.A.Sc., one of the research students at the McDonald Physics Building of McGill College, who also assisted me by making a spiral bridge-wire and parts of the small synchronous motor to my designs.—The Electrician.

The city of New Westminster, B. C., is resisting the proposal of a company to tap the water of the Coquitlan Lake, and develop electric power. The civic authorities believe that the city will require as a reservoir all the water supply over which it has a right.

The ELECTRICAL NEWS is indebted to the Royal Electric Company for a souvenir of the recent convention of the Canadian Electrical Association held in Montreal. It consists of a photograph, 15 by 20 inches in size, of the members and visitors to the convention, taken in front of the power house of the Chambly Manufacturing Company at Chambly, Que., in which, as our readers know, Royal Electric apparatus is installed.

A recent issue of the Electrical World contains a description of a new central station built by the Paris Compressed Air Company, of Paris, France, a concern which is engaged in electric lighting on an extensive scale. The general plan on which the lighting system of this company is laid out is one which has never come into use in Canada or the United States, being what is known as the five wire system, making use of an extension of the three wire principle. Current is generated at 500 volts, and distributed on two wire feeders to sub-station, wherein are storage batteries connected across the main, from which run five wire distribution systems, the pressure being equalized between the four ten-volt circuits of the distribution system in series with each other by means of batteries. In this way a great economy of copper is effected over the ordinary three wire system.

SPECIFICATIONS FOR THE LONDON ARC PLANT.

We have received the following letters relative to the specifications prepared for the installation of an arc plant for the city of London, Ont.:

Montreal, Sept. 5th, 1898.

Gentlemen: Replying to your favor of August 30th, I would say that it appears to be a pretty fair specification to cover this class of plant. Any criticisms which I have to make would be confined to the question of the advisability of placing restrictions on the tenderers which, if lived up to, may shut out good apparatus. For this standard apparatus the tenderer will offer his standard sizes, and any restrictions as to speed, efficiency, heating, etc., will have no effect on the tenders made, but may be used to block out certain bids when the contract is let. It appears to be more advisable, where standard apparatus is required, to request each tenderer to state and guarantee what his apparatus is capable of doing in regard to heating, regulation, efficiency, insulations, etc.

I also notice that no break down test is specified, but the insulation is to be 259,000 ohms, a figure much too low for this apparatus; the test in any case being useless except as a precaution before applying the high voltage test.

Yours truly,

Robert A. Ross, E. E.

St. Catharines, Ont., Sept. 7th, 1898.

Dear Sir,—We have looked over the specifications carefully and consider them very complete and a sufficient protection to the city. The only criticism we could make is that one particular style of arc lamp is mentioned under the heading of "Arc Lamps" in the first line of this article. There are probably several other lamps besides the Adams-Bagnell which would be equally as satisfactory and which could be obtained in Canada, whereas it would be necessary to import the Adams-Bagnell lamps at considerable expense. The size of dynamo and description would seem to indicate that the Brush 100 light machine was the one required. The specifications might have been broadened somewhat in this respect, though the wording is not such as to absolutely exclude other makes of dynamos.

Taken as a whole, the specifications are rather above the ordinary specifications met with in bidding on municipal plants, and aside from the items above mentioned contain no features which should exclude reputable manufacturers from bidding, while on the other hand the city appears to be amply protected, and should under such specifications obtain a very serviceable plant.

Yours very truly,

The Packard Electric Co., Limited.
E. E. Cary, Manager.

Montreal, Sept. 3rd, 1898.

Gentlemen: Not being directly interested in the manufacture or sale of arc light apparatus, the question is not of sufficient importance for us to give as complete criticism as you might desire. We may say, however, that on going over same we rather think as a whole the specification is, from the point of view of the engineer, a very good one, except that one has but to read between the lines to see exactly what class of apparatus is aimed at.

Briefly, we consider the specifications on dynamos good. Guarantee on dynamos altogether too excessive, as we do not see why any manufacturer should be compelled to practically offer a blanket insurance on the whole plant against fire, water or lightning for one year. The specifications for testing instruments are all right, except that we doubt whether an instrument can be made that will stand being left in current at all times without altering the calibration.

Arc lamps. In this section we may say that the engineer has had sufficient confidence in himself to name the style of arc lamp desired. Here we consider he should stop, without asking for such a complete guarantee as "shall be free from hissing, flicking or flaming when provided with ordinary commercial standard carbons"; also, where does the limit come in for "no complicated clockwork mechanism"? Lamp guarantee is fair; hangers and hanging equipment all right, except that manilla rope is not satisfactory for the work required.

Switchboard apparatus is fair, with the exception that we do not see why he should put in the clause "with least possible danger to short circuit or error." Why not make it "with no possible danger."

Line construction is apparently all right. Not being acquainted with local conditions can make no comment.

Wire. This section is lengthy without striking the point. The wire is to be covered with a triple covering of insulated material. Question: What class of insulated material is required, dry med or pure para rubber?

Acceptance of plant. We do not think it fair that such exacting specifications should be left in the hands of the city engineer or an electrical expert to be chosen by him, but rather that one should be named before, or mutually agreed upon. Finally, we would say that in our belief it is absolute folly in view of the present advanced state of the art, to install 9.6 ampere machines and open arc lamps for municipal arc lighting.

Yours respectfully,

John Forman,
Per Geo. H. Hill.

Picton, Ont., Sept. 19th, 1898.

Dear Sir,—In your September number you publish copy of specifications for electric plant for city of London, and ask for the opinions of electrical men on the same. I am not a manufacturer, neither am I what you would call an electrical engineer, but am somewhat interested in electrical work, and I therefore offer the following short notes on the specifications:

The specifications are, I think, so far as the city of London is concerned, very complete, but they are a shade hard on certain manufacturers. The first, and about the most objectionable feature that strikes me, is the guarantee of the dynamo. The engineer says "the machine or machines must stand a sudden short circuit for a period of five minutes." Now, who ever saw a 100 light dynamo, $9\frac{6}{10}$ amperes, about 75 horse power, that would stand a short circuit for five minutes and not burn up, and if the building was not fireproof it would surely set it on fire also. A regulator under those conditions would require to act very quickly, in fact I think it would have to shift the brushes from the heaviest point, where they would certainly be with 100 lights on a 100 light machine, to lightest point in five to ten seconds to avoid burning the dynamo very badly. Now, if regulator works in this short space of time, what is the use of limiting the test to five minutes. You may as well make it five hours, for the machines would not be generating any current after the brushes had been shifted to their lightest point.

As to the arc lamps, what is the use of asking for tenders and stating the name and style of lamp by specifying the Adams-Bagnell single carbon lamp? Does this not exclude all other makers of lamps from tendering for this part of the plant? If the Adams-Bagnell is the best lamp, and the city of London are bound to have them, why not buy them direct from the makers and thereby get a better price than they would by advertising and asking for a certain make of lamp. The makers, or agents for this lamp, can tender away up and still get the contract, as the corporation have already said we must have this make of lamp. Had the corporation asked for tenders in the usual way, they would likely have received a tender for this lamp, which would have been down among the rest; then they could have accepted this tender, and at the same time not caused the Adams-Bagnell Lamp Company to think that they were the only lamp makers in the world.

Yours truly,

T. O. Crandel.

Toronto, Ont., Sept. 23rd, 1898.

Dear Sir,—Replying to your favor of Aug. 30th, requesting my criticism of the London specifications, a copy of which you enclosed, would say:—

These specifications are quite comprehensive, and provide for a complete installation of high quality, hence a technical criticism will be more or less superfluous. Some adverse comments have, I believe, been engendered among a number of manufacturers of electrical apparatus by the action of the consulting engineer for the city of London in demanding through the specifications the furnishing of arc lamps made solely by a certain well-known company, and sold in Canada by themselves exclusively, thereby practically prohibiting or at least discouraging the makers of other lamps from tendering their respective types or makes. On this matter I have no objection to expressing my opinion as a consulting engineer.

Before dealing directly with the subject proper, it will perhaps be as well to briefly outline the position and duties to be reasonably expected of the consulting engineer in matters of this nature, in order that the apparent motives which actuated the city engineer in the present instance may the more readily be appreciated.

In the majority of proposed electrical enterprises entailing the expenditure of large sums of money, the general design and technical details of the installation are placed under the direction of an expert or engineer making a specialty of such work ; this engineer, after carefully ascertaining the conditions under which the plant will operate and the requirements it may be expected to fulfill, formulates the requisite specifications enumerating and describing the general and special apparatus to comprise the complete equipment, the number of each separate kind or piece of apparatus, its capacity and other necessary general details, and lastly, but most important, the minimum degree of good quality and perfection in the apparatus permissible to ensure favorable consideration of the tender. The tendency is now fortunately gaining ground among engineers to call for and insist on the purchase of only the highest and most perfectly developed apparatus, electrical or mechanical. Tenders are then received and examined by the engineer, and those providing for that quality of apparatus best adapted to meet the requirements fully are usually recommended for acceptance. I say "usually recommended," since it occasionally happens that limited finances exert a strong influence in determining the quality of the apparatus to be accepted by the purchaser. Assuming the highest quality to have been accepted on the engineer's recommendation, after reception and examination of tenders, at least two very important results will have been attained : Firstly, the purchaser of the apparatus will have benefitted to an appreciable extent financially through the competitive prices received from the manufacturers of an acceptable grade of apparatus ; and secondly, a very strong incentive will have been offered the manufacturers to continue developing and improving their several lines of manufacture to the utmost limits of perfection cotemporaneously attainable—an incentive which cannot fail at least ultimately in producing results having an inestimable value for the human race in general.

It seems to me that the city engineer of London has faithfully endeavored to fulfill the duties of his responsible position with the above ends in view, since he has not only provided for the supplying of what he believes to be the best arc lamp on the market, but has otherwise specified qualities in the remaining portions of the plant which are certainly of a high degree. What his reasons are, however, for concluding that but one make of arc lamp is above all others the best adapted to meet the particular requirements of his clients I do not propose to discuss, and will therefore await his reply or explanation, if he be disposed to publish one. For my own part, I am of the opinion that when articles or apparatus of general manufacture, such as arc and incandescent lamps, supplies, dynamos, engines and boilers, etc., are to be purchased by tender, it will be more to the advantage of all concerned (the clients as well as the manufacturers) for the engineer to avoid specifying any particular make, even though it be of a type slightly different from the average, and instead to so present the requirements, conditions and guarantees to be fulfilled, etc., by means of a reasonably close specific description or general specifications, that the supplying of the requisite quality or essential type of apparatus can be provided for under the usual conditions.

If the engineer should feel justified in purchasing a specific make of apparatus before tenders for the remaining portions of the equipment are asked, and accordingly signifies this intention in his specifications, he renders liable the establishing of a precedent which has repeatedly proven detrimental to the best interests of clients and the electrical business in the United States. The reason for this should be apparent to the readers of your valuable paper who have had experience in these matters.

Yours very truly,

RODERICK J. PARKER.

PERSONAL.

Mr. Gardner, of the Ottawa Electric Company, has taken charge of No. 2 power house.

Mr. F. A. Cambridge has been appointed electrician for the city of Winnipeg, Man. One of the chief duties will be the inspection of electric wiring.

Mr. Alex. Hunter, for over thirty years assistant chief operator for the Great Northwestern Telegraph Company, Toronto, died last month. He was well known to the telegraph fraternity throughout the Dominion.

Mr. Charles B. Routh, of the Ottawa Electric Light Company's arc light station, has severed his connection with the company, and will in future reside in British Columbia, where he has secured a lucrative position.

The honor of being elected a member of the Executive Committee of the Street Railway Accountants' Association of America was conferred upon Mr. J. D. Fraser, secretary-treasurer of the Ottawa Electric Railway Company, at a recent convention.

Dr. John Hopkinson, the well-known English electrical engineer, was killed at Berne, Switzerland, while ascending the high Alps without a guide. Dr. Hopkinson had devoted much attention to electrical research, having given the results of his experiments in various papers read before the Royal Society and other institutions. In the year 1893 he made some improvements in the Edison dynamo, which proved to be of exceptional importance in dynamo construction. He developed to a large extent the theory of alternating dynamos, and received from the Westinghouse Company the sum of $9,000 for his British patents on the three-wire system of distribution, which he invented simultaneously with Edison in the United States. At the time of his death, it was Dr. Hopkinson's intention to shortly sail for New York, to form a syndicate to develop other recent inventions.

The Maritime Sulphite Fibre Co., Chatham, N.B., have ordered a 500 h.p. cross compound condensing engine from the Robb Engineering Co., to replace their present 250 h.p. simple engine and to provide for contemplated enlargements of their plant. They expect their new engine to effect a large saving in fuel over the type they are now using, as well as to give much better speed regulation.

CANADIAN ELECTRICAL STUDENTS' COMPETITION.

IT is the intention of the publishers of the ELECTRICAL NEWS to offer two or more prizes to students of electricity in Canadian schools and universities, for the best essay on a specified subject. The conditions and full particulars will be published in the ELECTRICAL NEWS for November. Meanwhile, it can be stated that the proposal has been favorably received by the authorities of some of the leading schools. It is hoped that the students for whose benefit chiefly the competition is being instituted, will take an active interest and thereby ensure its success.

PROF. R. B. OWENS.

PROFESSOR R. B. Owens, E.E., who has recently received the appointment to the W. C. McDonald Chair of Electrical Engineering at McGill University, Montreal, in succession to Professor Carus-Wilson, is a comparatively young man. He was chosen from among the teaching staff of the great universities of the United States, and brings with him a record for marked originality, ability and energy.

Professor Owens was born in the southern part of Maryland, a state of which his mother's great grandfather was the first Democratic governor. He spent three years in an old military school at Maryland, and was the youngest to graduate since its founding in 1774. After a brief connection with the old Baxter Motor Company, he resumed study at Johns Hopkins University in Baltimore, under Dr. Louis Duncan, and obtained a high standing in mathematics and physics. He was then for a time with the Excelsior Company in New York, and put in and superintended the Thomson-Houston station at Greenwich, Conn. In the year 1891 he obtained the degree of E.E. from Columbia University, having been a student under Professor Crocker.

PROF. R. B. OWENS,
Professor of Electrical Engineering, McGill University Montreal.

In his organization work at Nebraska University Prof. Owens attained a high degree of success. He was first appointed Adjunct Professor of Electrical Engineering upon the opening of that department, becoming professor in 1894, and in 1895 he assumed full charge of the Department of Electrical and Steam Engineering, which position he resigned recently. While thus engaged he succeeded in building up the engineering course of that university to a high standard. He was one of the judges of electrical exhibits at the World's Fair. Prof. Owens has recently been elected to a Tyndall Fellowship by Columbia University, and is director of Bureaus of Electricity and Machinery at the Trans-Mississipi Exposition at Omaha. He is also a member of the Western Society of Engineers, the American Society of Mechanical Engineers, and the council of the Society for the Promotion of Engineering Education, and vice-president of the American Institute of Electrical Engineers.

ELECTRIC GONG BUOYS—AUDIBLE VERSUS VISUAL SIGNALS.*

By F. A. Hamilton, E.E.

It is now some five years or more since I first made the proposition contained in this paper, viz., to make use of electricity for the purpose of facilitating navigation, more especially in providing a system of signal buoys by means of which the mariner would be enabled to reach his destination with comparative ease and safety, under conditions which normally would be both difficult and dangerous. The idea formulated was briefly as follows:

To connect by means of a submarine cable a system of buoys, fitted with powerful electric gongs, these buoys to be placed in the offing in such positions that vessels could, without risk, run to leeward of them and consequently come within range of the gong signals.

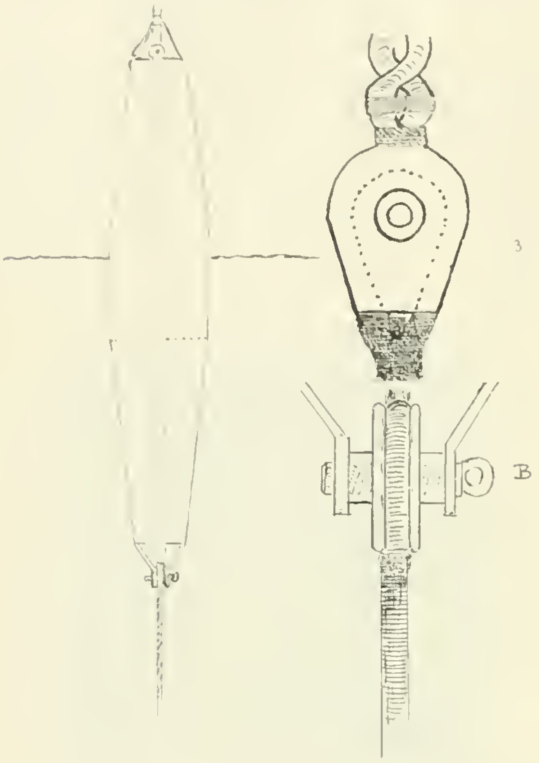

Fig. 1.

It is well known that whilst even the report of a cannon can be heard but a short distance to windward, the camparatively feeble note of the automatic whistling buoy will be distinctly audible five or six miles to leeward. Bearing in mind this fact, it would seem reasonable that the vibrations which it is possible to cause by striking a bell by means of power produced and controlled by electricity could be heard some considerable distance down the wind. With this object in view I planned out the system hereinafter described.

Before proceeding to explain the details of the method proposed, I would beg to be permitted to submit a few observations with regard to the necessity of providing means for facilitating the entrance of vessels to our harbors.

Whilst it cannot be denied that the whistling buoy, commonly known as Courtney's automatic buoy, has done, and is doing good service, it must be admitted that something more is needed in the way of guides to the mariner, for these ponderous whistling buoys must necessarily be moored in shallow water, and, consequently, in the majority of cases, near the shore, so that in the endeavor to "pick up" the sound of the whistle it is necessary to run the vessel nearer to the shore and to outlying dangers than is desirable. Let us take the approaches to Halifax Harbor as a typical case.

An automatic buoy is moored on the Outer Bank, 5 miles from Sambro light, in a depth of twenty-four fathoms, and another nine miles to the north-eastward of this in 37 fathoms. To stand in to leeward of these buoys in thick weather during a southerly gale would be a hazardous proceeding, as there are many outlying dangers in the vicinity.

Taking into account the fact that the conditions of weather are such that south in the wind means fog, rain or snow, it is evident that a vessel must pass inside the buoy, that is to say, between it and the land, before the sound of the whistle will be heard. There are times, it is true, when the buoy signal will be audible in the other direction, for instance during fog unaccompanied by wind, but the point I wish to emphasize will be at once recognized when the combined conditions of a south-east gale with rain are considered. Under these circumstances we have thick weather and, for a vessel approaching the land, a lee shore. The vessel has perhaps made a rapid passage across the Atlantic. A master of ortho-dromics has navigated the latest triumph in marine architecture to within an hour's run of her destination, but, owing to thick weather, and the absence of any indication as to his whereabouts, the prudent mariner has perforce to point his ship to the wind and await more favorable conditions. It is possible that after groping about in the fog and rain, anxiously listening for the moan of the automatic buoy, and continually heaving the lead, the worn out but vigilant commander is fortunate enough to come within the range of the spasmodic toot of the buoy, but the chances are against any such lucky hit, and at the very best many hours are lost in the endeavor to establish the position of the ship, under conditions not altogether unaccompanied by danger.

Now, what would be of incalculable value to the mariner could be provided by means of a system of audible signals placed broad off in the offing at such a distance that vessels could boldly stand in to leeward, and therefore be sure of coming within range of the signals.

In order to multiply the chances of attaining the desired result, at least three buoys should be distributed across the approaches to the harbor, in a manner to be hereafter determined by those who are the best qualified to select the respective positions. The writer would here merely suggest the placing of these buoys in the positions indicated on the accompanying chart, on which it will be seen that the distribution is such that in standing across, in perfectly safe water, and parallel to the coast, a vessel could pass to leeward of the buoys, so that in approaching the vicinity of the harbor, a few short runs in the direction shown by the arrows would bring the ship near to and to leeward of one of the buoys.

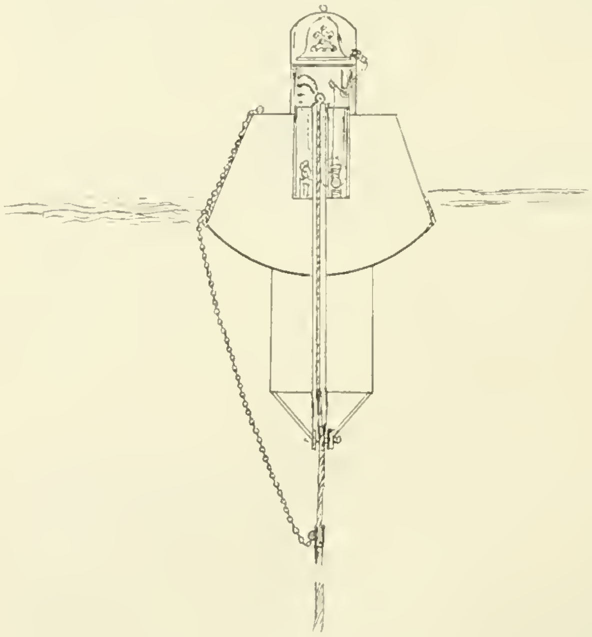

Fig. 2

It is, of course, well known, and recognized, with no small degree of admiration for the skill and nerve displayed, that there are certain captains for whom the weather is always clear—that is to say, it is never too thick to prevent their running in, even to the very wharf, without a glimpse of anything, save perhaps the ghostly form of Meagher's Beach light-house—but it is only fair to state that such instances are not the rule, and here it may be remarked that the chief object aimed at is to assist the ocean liner and other vessels that have run long distances, and not so much the coaster, with a comparatively short departure. At the same time, the fact must not be lost sight of that the additional facilities here proposed would be of inestimable value to every description of craft, including pilot vessels, which could, under the conditions proposed, patrol in safe waters.

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* Paper read at the first convention of the Maritime Electrical Association, September 27th, 1898.

Having indicated in a cursory manner the needs and objects of the proposed scheme, I now proceed to the details connected with the apparatus required. This part of my subject may be conveniently considered under the following heads, viz., buoys, moorings, fittings, cables and signalling appliances. A suitable form of buoy is that known as the "spar buoy," which consists of an iron cylinder terminating at each extremity in the frustum of a cone. Such a buoy is shown in Fig. 1, in which a sectional elevation is presented. The fittings consists of shackles, thimbles, bridle chain, staff and junction box. The moorings consist of the cable itself, connected to the buoy in the manner hereinafter described. Another form of buoy is shown in Fig. 2. The shape is that of a truncated cone, the base of which is the segment of a sphere with a cylinder attached, a cylinder being also recessed in the cone for the reception of a detachable cylindrical box in which the electrical and mechanical appliances are placed, and over which the bell is supported. A tube through which the cable is led is run through the middle of the buoy.

The upper part of the buoy not including the cylindrical portion is the air chamber, and the lower part provides a space for water ballast, and at the extremity of this two arms are attached, between which the cable is secured in the manner shown at B, Fig. 1, and at A and B, Fig. 3. The two parts of the cable are crossed and "seized" and worked over the thimble (b), and further "seized" below the latter. Above the thimble the two parts, twisted together and served, are led through the pipe inside the buoy, or up the side of the buoy if necessary, protection in this case being afforded by means of battens or other suitable appliances. A bridle is attached below the thimble and secured at a convenient place, for the purpose of facilitating the operation of disconnecting the buoy from the cable.

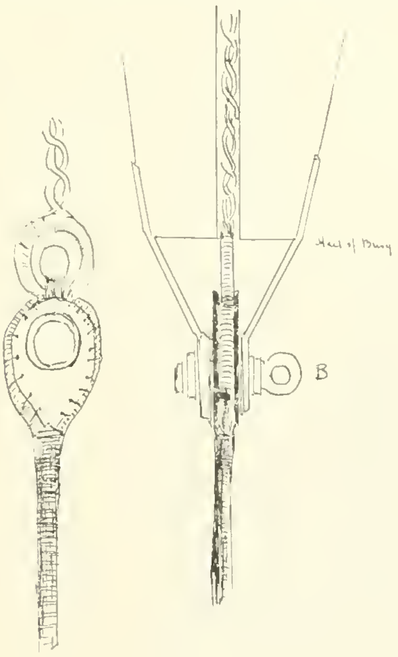

FIG. 3.

The main line—that is to say, the cable connecting the outer position with the station on shore—I divide into as many sections as there are buoys. Each section is connected by means of couplings, the ends of the sections being fitted with thimbles through which the coupling bolts are passed.

The coupling pieces consist of two cast iron plates, in which are three bolt holes and three slots. These plates are crowned or rounded above and below in order to provide a hollow chamber for the cable connections.

The bolts serve the double purpose of holding the two plates together and securing the cable ends to the couplings. The hollow receptacle affords protection to the joints between the main cable and the branch lines leading to the buoy. A suitable sort of coupling is shown in Fig. 4. The main cable ends 1 and 2 and the branch cable 3 are placed in their respective slots and secured in position by means of the top plate and the bolts, as shown in the diagram.

The yoke and chain are for the purpose of facilitating the operation of buoying the bight, as explained hereafter.

The following modus operandi is proposed: The cable having been paid out from the shore to the end of the first length, the second section is connected to it by means of the coupling. Having carefully joined the cores and secured the two ends of the cable to the coupling by means of the bolts, paying out is resumed, and at the same time a small anchor buoy is slipped with a convenient length of rope attached, the connection being thus readily accessible.

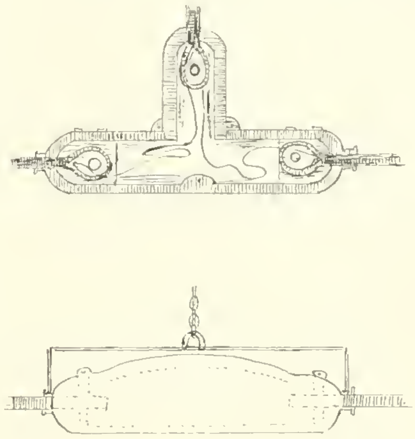

FIG. 4.

The yoke to which the chain carrying the buoy rope is attached is for the purpose of preventing the anchor buoy tackle from being twisted up around the coupling as it and the cable are lowered to the bottom.

The same operations are performed at the end of each section, with the exception of the end one. Here the first branch cable is connected by a perfect joint between it and the main line. The branch cable, being paid out to near the end, is secured to the buoy and the latter is slipped. The cable is then picked up at the various couplings and the branch lines connected and paid out at right angles to the main cable.

As the buoys are moored by the cable itself, it is necessary that this be provided with some protection against abrasion. This object is effected in the following manner: A rounding of chain is applied over a length of cable depending on the depth of water in which the buoy is moored and the nature of the bottom. It is to render the examination of this portion of the system comparatively easy that paying out at right angles to the main cable is recommended; besides this, it reduces the chances of wear and tear on the main line, which remains undisturbed whenever the buoy moorings are examined.

The following explanation concerning the operation of attaching a buoy to a branch cable may be of interest: Having paid out a branch line to within a few fathoms of its end, attach a slip rope. Pass a heaving line down through tube of buoy and bend on to thimble at end of cable, pull the latter up the tube, remove cover placed over the cores for protection, secure the conductors to their respective terminals in the connecting box, insert pin through eye of thimble and close the box, at the same time pass bolt through thimble of cable at heel of buoy, attach bridle chain to cable and secure it to tripod of buoy. Drop buoy and cut slip rope. In picking up the buoy and moorings the following precautions should be observed: On disconnecting the junction box, attach a "tail" of heaving line through the eye of thimble, in order to provide a means of saving the ends of core from being used as a lanyard. Secure cover over tube and close junction box. Shackle on bridle chain, heave away and cant buoy; remove bolt at heel of buoy. In order that the bolt may be easily withdrawn when the strain is taken up by the bridle, the latter may be attached to the cable at a distance of about a fathom below the thimble that carries the bolt by which the cable is secured to the buoy.

THE SIGNALLING APPARATUS.—In my original design the plan was to employ electro magnets and gongs, of large dimensions, placed on the flagstaffs. The following is an extract from a letter dated January 31st, 1893, in which I explained my proposed scheme:

"In reply to enquiries respecting my proposed system of electric bell buoys, I beg to furnish the following information: Electric bells when exposed to wet or moisture are apt to fail owing to the contacts becoming oxidised, and this is probably the chief reason why electricity has not been applied, in the manner now suggested, to marine signalling. To obviate the difficulties hitherto presented and to protect the electrical contacts from the action of damp and salt, I enclose the electro magnet and contacts in a sealed chamber or box, which whilst being impervious to water does not impair the action of the rod to which the bell hammer is attached. The sealed box containing the electro magnet is, together with the gong mounted on a cage, supported by a staff which is carried by a tripod attached to the buoy. The electric cable is passed through a tube in the buoy or up the outside of the latter and connected to the terminals in the box. The cable is attached to the buoy in the following manner: Two parts of the cable are crossed and "seized" and worked over a thimble and further "seized" and served below the thimble. A bolt passed through the eyes of the arms of the buoy secures the thimble, which carries the cable to the buoy. The ground parts of the cable are protected from abrasion by a "rounding" of chain applied over a sufficient length to not only provide against chafe, but to ensure enough weight to moor the buoy. The type of cable recommended as most suitable for mooring the buoy consists of one made up of two closings of armor, applied in opposite directions in order to prevent any tendency to twist or kink."

Here followed a description of buoy, moorings, etc., and an estimate of cost.

The feasability of the system here proposed could be easily and economically proved by means of some old cable and a buoy of suitable dimensions fitted in the manner described."

The advantages claimed for this method of producing audible signals are:

1st. The certainty of the sound being emitted during calm weather when there is not sufficient swell to cause a whistling buoy to act.

2nd. Its usefulness for positions where there is no swell, such as in rivers, harbors, and channels not open to the sea.

3rd. The convenience with which the apparatus can be handled, the buoys, and consequently the moorings, being light.

4th. Its adaptability for positions in deep water where the mooring of a whistling buoy would be attended with great difficulty.

In positions where only a short length of cable would be required to connect the buoy and the shore the cost would be small, and in places where the water is smooth and the bottom favorable, light buoys and moorings could be used. There are doubtless many positions where the system would be of great value.

In reconsidering this matter I have recognised the necessity for providing a system by means of which each buoy would signal its own number, and the plan is to arrange the apparatus in such a way that in the case of a system comprising several buoys only one is in circuit at a time, so that the full power available on the line is concentrated at one point. In the case of three buoys—whilst number one buoy is striking its number, the other two are out of circuit, and when buoy two is in operation, one and three are mute, likewise when number three appeals to the elements, one and two are silent.

The simple mechanism required to accomplish this result consists of a small electric motor, which, besides performing the operation of working the lever which connects the rod leading up to the bell hammer, winds the spring of a system of clockwork by means of which the current is switched on and off at each buoy.

This portion of the apparatus, together with the bell, can be readily shipped and unshipped, so that the appliances can be easily examined an overhauled. There are possibly others who have taken up this subject since I first mooted the question. It would be interesting to know what advances they have made, and it is to be hoped that the remarks contained in this paper will give rise to such discussion as may pave the way to practical results, for there can be little doubt but that much useful work is to be done in the direction indicated.

In conclusion, I desire to state that I emphatically disclaim any intention of reflecting on the usefulness of electrically lighted buoys or of automatic whistling buoys, both of which are of the utmost value in their respective spheres. I merely claim for the system concerning which your opinion is asked a place in the advanced line of our littoral outposts.

TRADE NOTES.

The McLaughlin Carriage Co., of Oshawa, Ont., have ordered a 100 horse power Robb-Armstrong engine from the Robb Engineering Co., Amherst, N. S.

The Warwick Clothing Manufacturing Company, of Warwick, Que., are lighting throughout by electricity. The order for the necessary apparatus has been given to the Royal Electric Co.

Messrs. Boivin, Wilson & Company, of Montreal, have recently ordered from the Canadian General Electric Company a 100-light incandescent dynamo for their premises at Berthier.

The Lachine Rapids Hydraulic & Land Co. have awarded to the W. A. Johnson Electric Co., of Toronto, a contract for all the transformers (of the Wagner type) required for a year.

The Canadian Pacific Railway have purchased from the Royal Electric Company one of their 50 light 2 000 candle power arc dynamos, together with 52 arc lamps, for use in their car shops at Hochelaga.

The exhibit of John Starr, Son & Co. at the recent Halifax exhibition was very creditable and attracted much attention, being awarded a diploma and medal by the judges. The current used for the illumination was generated by their dynamo in Machinery Hall. Two telephone switchboards were to be seen, for fifty subscribers each, gotten up in handsome cases. Two styles of telephones were exhibited, stationary for the wall and portable for desk use. These instruments are made by John Starr, Son & Co., and are fitted with the new Starr transmitter, patented in Canada and elsewhere, the feature of which is the double diaphragm, enabling sound to be transmittsd with increased distinctness. They are adapted for either long or short distance telephoning, and cannot easily get out of adjustment. They also show a complete line of electric supplies.

SPARKS.

The Northey Mfg. Co., of Toronto, are building a horseless carriage, to be propelled by a [illegible] h.p. gasoline engine.

Messrs. H. Vick & Sons, of Orillia, recently ordered from the Canadian General Electric Company a 50 light incandescent dynamo.

The town of Newmarket, Ont., has granted a franchise for an electric railway to the Metropolitan Railway Company.

A young man named Aikens was killed last month by the explosion of a boiler in the brickyard of F. W. [illegible], near Tavistock, Ont.

The Fredericton Electric Company have under consideration the erection of a new power house, rendered necessary by insufficient accommodation.

The Midland Elevator Co., of Midland, Ont., are having placed in their elevator a fifty light T. H. dynamo, from the works of the Royal Electric Company.

The Deseronto Iron Company, of Deseronto, Ont., have closed a contract with the Canadian General Electric Company for a 200 light dynamo, with marble switchboard for same.

The Packard Electric Company, Limited, of St. Catharines, Ont., have issued a neat booklet, giving the code word for various terms and phrases used in the electrical supply trade. This should prove very useful to central stations.

Messrs. Tromanhauser Bros., of Goderich, have placed an order with the Canadian General Electric Company for a 200 light incandescent dynamo which they propose to install to light their elevator buildings.

The Bell Telephone Company expect to have their new building in Quebec completed early in January. The company are also doing considerable work in the way of placing large cables underground.

The British Columbia Electric Railway Company, in order to meet the increased traffic over their road, recently placed an order with the Canadian General Electric Company for additional car equipments of the well-known C.G.E. 1,000 type.

Mr. Percy Domville has been instructed by the Hamilton City Council to prepare an estimate of the cost of an electric light plant, buildings, etc., for 500 arc and 3,000 incandescent lights, and for 700 arc and 5,000 incandescent lights.

The Y. M. C. A. of Montreal have established a course for the study of electricity, under the direction of Mr. Louis A. Herdt, E. E., of McGill College. The department will be equipped with the latest apparatus for experimental work.

It is rumored that, as a result of the franchise granted by the city of Ottawa to the Metropolitan Electric Company, the Deschenes Electric Company will again renew its effort to secure a franchise for electric light and power from the city.

The Canadian Pacific Railway smelter at Trail, B. C., recently placed an order with the Canadian General Electric Co. for a 50 light 2,000 c.p. Brush arc dynamo, together with the necessary lamps for same. These are to be used at their smelter works at Trail.

Messrs. John Ballantine & Son, of Preston, have given a contract to the Canadian General Electric Company for a lighting plant, including a 100 light dynamo with instruments. The order includes the wiring up of their premises for use of incandescent electric lighting.

The storage sheds of the Montreal Street Railway Company at Hochelaga were destroyed by fire on September 16th. Sixty cars were burned, on which there was an insurance of $2,500 each. Seven sweepers, just half of the company's equipment, were also destroyed.

The city council of Hamilton, Ont., has agreed to extend the franchise of the Hamilton Street Railway Company for fifteen years from 1913. It is said that as a result of this extension, the company will undertake considerable improvements to the system at an early date.

The scheme to utilize the water power of Whiteman's Creek for the supply of electric light and power to the city of Brantford, Ont., and vicinity, has been revived. There is a head of 18 feet, and the dam and race are in good condition. The promoters claim that 75 h.p. could be obtained the year round.

The village council of Acton, Ont., have appointed a committee to visit Aurora, Newmarket, and other places where municipal electric plants are in operation, and secure all possible information on the subject. The report which will shortly be presented, will likely recommend the installation of a plant by the village.

The earnings of the Toronto Street Railway Company for the fortnight commencing Monday, August 29th, and ending Saturday, September 10th, 1898, were the largest on record. During the two weeks the company carried 1,879,298 passengers, making a total increase in receipts over the same period last year of $15,167.11.

The Hamilton Blast Furnace Company, of Hamilton, Ont., have given a contract to the Canadian General Electric Company for the installation of a 150 light incandescent dynamo, with switchboard and the necessary instruments, and are also having their factory wired up for the use of incandescent lights and long burning direct current arc lamps.

The new contract between the city of Brantford and the Brantford Electric and Operating Company came into force recently. Instead of arc lights of 68,000 candle power, there are now over 200,000 candle power, while the price has been reduced from $8[illegible].95 to $53 per lamp. Incandescent lights have been reduced from $10 for 16 c.p. lamps to $9.60 for 32 c.p.

The T. Eaton Company, Limited, of Toronto, have given an order to the Canadian General Electric Company for the installation of a 130 kilowatt direct connected generator, with marble switchboard, containing the necessary instruments for the generator. When this generator is installed the T. Eaton Company will have three 130 kilowatt generators and two 50 kilowatt generators of the Canadian General Electric Company's well-known type.

The annual meeting of the Great Northwestern Telegraph Company was held in Toronto on September 28th, at which the following directors were re-elected: H. P. Dwight, president and general manager; Adam Brown, of Hamilton, vice-president; H. N. Baird, James Hedley, A. S. Irving, W. C. Matthews, of Toronto, Richard Fuller, of Hamilton, Hon. William McDougall, C.B., of Ottawa, and Charles A. Tinker of New York, directors; George D. Perry was reappointed secretary and auditor, and Arthur Cox treasurer. The statement of the year's business showed a considerable improvement over the previous year.

A public demonstration of the Bonner rail waggon, as described by Mr. W. T. Bonner in a paper read at the last convention of the Canadian Electrical Association, was made at Toledo, Ohio, on September 9th, and was regarded with much interest by the public. Col. Bonner showed how the wagons were unloaded from the trucks by means of incline planes, and how they were again loaded by reversing the former operation. Packages will be carried at the rate of 10 cents per hundred pounds, with a regular rate for carloads. The company will have regular schedule time for through trains to outside towns, and will do a general freight business in traffic which is too small for the railroads to handle advantageously.

A meeting of the shareholders of the Royal Electric Company has been called for October 18th, for the purpose of authorizing an issue of preferred stock, and the acquisition of shares in the Chambly Mfg. Co. for an additional amount of $100,000. In 1894 and 1895 the company sold in England $750,000 of its bonds, bearing 4½ per cent. interest. $37,500 of said bonds being redeemable and redeemed every year. By pledging preference stock the company is now in a position to command capital in England at a materially low rate of interest. In view of the continued and constant growth of the company's business, demanding large extensions and additions, the board of directors deem it advisable to raise, for the time being, additional capital in England by means of a loan on the pledge of preference paid-up stock.

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

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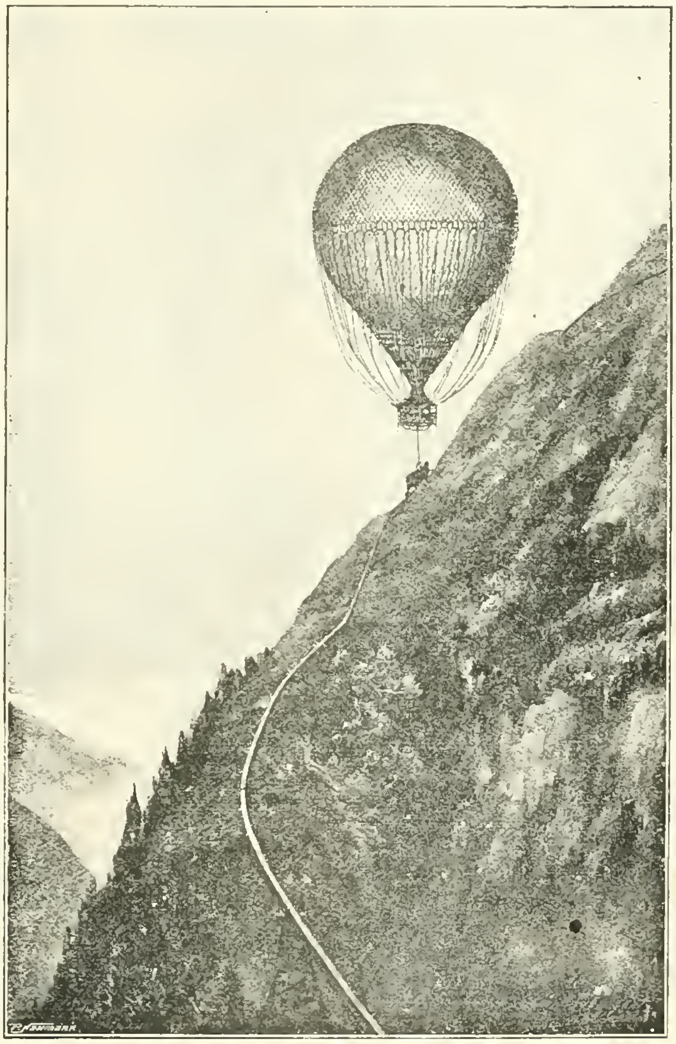
NOVEL MOUNTAIN RAILWAY.

IN the July issue of the World Wide Magazine, published in New York, we find an article on "Mountain Railways," by Mr. Salvatore Pannizzi, who describes and illustrates some of the novel railroads built over precipices and mountains in different parts of the world. One of these, in the Australian Alps, is operated by a balloon, as shown by the accompanying illustration. Concerning this peculiar railway the writer says:



NOVEL MOUNTAIN RAILWAY.

The last mountain railway we have to deal with is, perhaps, the most extraordinary of all, the motive power being not steam, nor electricity, but a balloon! Stranger still, the official stamp of approval has just been put upon this marvellous railroad, which goes to and from the summit of Hochstauffen Mountain at Bad-Reichenhall, the well-known watering place in the Austrian Alps. The Aerostatic Railway—to give it its correct designation—owes its inception to the well-known inventor, Herr Volderauer, who had long ago convinced the experts that his scheme was perfectly feasible and safe. A single rail guides the cars, and keeps the balloon with its load captive, the cars gripping the rail at the sides and underneath the flange. At about every 15 feet the line is firmly anchored. In descending the mountain, of course, gravity is the propelling force, water-ballast being taken aboard at the upper end to counterbalance the buoyancy of the balloon. The cock on the water-tank of the car can be opened by the operator at any time. The tank carries about 800 lbs. of water, and tank and car together weigh about 600 lbs. The balloon is 67 feet in diameter, and exerts a lifting capacity of something over 11,000 lbs. Weights, also, can be taken aboard and discharged at the various stations along the line. At the foot of the track are the gas-tank and generator. The summit of the Hochstauffen offers a sublimely beautiful view; but before the advent of the Aerostatic railway the climb was both long and tedious. It was only attempted by experienced mountaineers. The illustration shows the balloon dragging up its car on the single rail.

THE GAS ENGINE.

In a paper read before the North British Association of Gas Managers, Mr. W. C. Peebles thus spoke of the gas engine: "There can be no doubt that a great deal has yet to be done to improve the action of the gas engine. The main direction in which a change must be looked for is, I think, in the cycle. But this would seem almost impossible without introducing complicated mechanism. At present—at least with the smaller sizes—the successful competition of the gas engine with the steam engine is chiefly due to the convenience and economy with which the gas engine can be operated, especially for intermittent work. With engines above 40 or 50 horse power, using producer gas, the cost of working is greatly in favor of the gas engine, as has been proved time after time. We shall find, therefore, that large gas engines will not stop at 400 or 500 horse power, but increase gradually year by year until they compete in power with the largest steam engines made. What the gas engine has done for the benefit of small masters it is impossible to estimate. Many hundreds of these employers were driven out of existence by the introduction of the steam engine. But they are gradually springing up again, and, with the aid of the gas engine, they are able to secure a respectable share of the trade. That the gas engine will rank in the near future as one of the chief sources of power there can be no doubt."

REPORT ON LIGHTING PLANT FOR CITY OF HAMILTON.

A REPORT has been presented to the city council of Hamilton, Ont., by Mr. Percy Domville, on the cost of installing and operating a municipal electric lighting plant. For the purpose of comparison the report is in two divisions: First, description and cost of installing and operating an arc plant for lighting of city streets, with an addition to arc plant for civic incandescent lighting; and second, description and cost of installing and operating an electric incandescent lighting and power plant, for both commercial and civic purposes, in connection with an arc lighting plant.

ARC LIGHTING PLANT.

In describing the proposed arc lighting plant for 500 lights, Mr. Domville states that one 500 horse power tandem compound condensing engine and condensor, capable of supplying power for 550 arc lamps of 2,000 c.p. each, or 650 arc lamps of 1,200 c.p. each, will be required. The necessary boiler capacity is given as 636 h.p., in three units. Two boilers would be sufficient, but he deems it advisable to have one in reserve. Five 125 light self-regulating series arc dynamos, capable of sustaining a steady current of 9.6 amperes, or 2,000 c.p. per lamp, are provided for, leaving one dynamo to spare. With the increase of the number of lights to 700, another dynamo would be required, but in view of the improvements being made, he recommends the postponement of the purchase until such machine is required. Five hundred double carbon arc lamps of the clutch type, each of 2,000 c.p., with globes, cut-outs, etc., fitted for 5/8 carbons, are specified. The lamps are to be divided into nine circuits of 55 lamps each. As to maintenance, Mr. Domville states that by locating the plant adjoining the sewage interception works, the present engineer and fireman could be used, and, with an assistant, would be sufficient to operate both steam plants. With the latest type of compound condensing engines, fitted with economizers, etc., a great saving of fuel could undoubtedly be effected. The amount of coal required is variously estimated from 5 pounds per horse power per hour for a simple non-condensing engine to 1,765 pounds per horse power per hour for a triple compound condensing engine. Taking 4 pounds per horse power per hour as a fair estimate, assuming the efficiency of engines and generators to be 90 per cent., and efficiency of line to average .93 per cent., one pound of coal will, the report states, produce 140.49 watt hours. The estimate provides for four generators running ten hours per day, each 9.6 amperes, 6,250 volts, or a total output of 2,400,000 watt hours per day. Estimating 140.49 watt hours per pound of coal, the amount consumed daily would be 17,083 pounds, or an annual consumption of about 3116 tons.

An addition to the above plant for the purpose of supplying 1000 lights for civic incandescent lighting would, it is stated, necessitate increasing the size of the engine from 500 to 600 horse power, and installing a 50 k.w. alternating dynamo of 1000 light capacity, with exciter and small switchboard. Additional wires, transformers and poles would also be required, and the cost of operation would be slightly higher. The present consumption is 125,000 watt hours. Assuming that one pound of coal will produce 140.49 watt hours, an additional consumption of 888 pounds per day, or 162 tons per annum, is figured upon.

Estimates of the cost of installation and operation of a plant as above are given as follows:

APPROXIMATE COST OF INSTALLING A CIVIC ELECTRIC ARC PLANT OF 500 LIGHTS.

STEAM PLANT—		
One (1) 500 horse power tandem compound condensing engine and condensor, erected and connected ready for operation	$5,000 00	
Three 212 horse power boilers, erected and connected ready for operation	11,550 00	
One boiler feed pump	300 00	
Contingencies	2,000 00	
		$18,850 00
ELECTRIC PLANT—		
Five (5) self regulating series arc lighting dynamos, 125 2,000 c.p. lights capacity, at $2,750	$13,750 00	
One (1) ten circuit switchboard, complete	300 00	
500 double carbon arc lamps, with globes, at $25	12,500 00	
500 lamp hangers, at $5	2,500 00	
50 miles of line No. 6 B. & S. weatherproof wire, at 16 cents per pound	4,000 00	
1,750 cedar poles, with one cross arm, at $3	5,250 00	
Setting same, at $1	1,750 00	
Insulators and pins	150 00	
Erecting wire, $10 per mile	500 00	
		40,700 00
BUILDING, ETC.—		
Building and chimney	$30,000 00	
Belting	830 00	
Pulleys	250 00	
Shafting, etc	500 00	
Publishing by-law and incidental expenses	1,000 00	
Contingencies	5,000 00	
		37,580 00
Total		$97,130 00

ANNUAL COST OF OPERATING CIVIC ELECTRIC ARC PLANT OF 500 LIGHTS.

Coal, 17,083 lbs. per night, or 3,117 tons per annum, at $2 per ton	$6,234 00	
Carbons, 500 pair per night, at 1½c. per pair	2,737 00	
Oil and waste	300 00	
LABOR.—1 superintendent and electrician	1,800 00	
1 chief engineer	900 00	
1 assistant engineer	700 00	
1 fireman	600 00	
1 dynamo tender	600 00	
1 lamp repairer and tester	600 00	
3 trimmers, at $500	1,500 00	
2 linemen, at $500	1,000 00	
1 patrolman	500 00	
1 laborer	450 00	
Keep of 4 horses	500 00	
Office expenses, stationery, etc.	600 00	
Depreciation, 5% on $97,130	4,856 50	
Interest on $97,130 at 3½%	3,399 55	
		$27,277 05
Cost of arc light per annum	$54 55	
" " " " night	.1493	

The following is given as the comparative cost of installing and operating 1,200 and 2,000 c.p. lamps for one circuit—60 2,000 c.p. = 75 1,200 c.p. lamps:

60 double carbon arc lamps, 2,000 c.p., at $25	$1,500 00	
75 " " " " 1,200 c.p., at $25	1,875 00	
MAINTENANCE—		
Carbons, 2,000 c.p. =	328 50	
Repairs, 2,000 c.p. =	65 00	
		$393 50
Carbons, 1,200 c.p. =	410 62	
Repairs, 1,200 c.p. =	93 75	
		503 37

CIVIC INCANDESCENT PLANT.

Following is the additional cost of installing and operating an electric incandescent lighting plant for civic purposes only—1,000 incandescent lights:

STEAM PLANT—Size of engine increased from 500 h.p. to 600 h.p.	$1,000 00	
Boiler h.p. increased proportionately	1,750 00	
		$ 2,750 00
ELECTRIC PLANT—One 50 k. w. = 1,000 light alternator	2,500 00	
40 transformers, 25 lights, at $32.50	1,300 00	
10 miles of feed wire No. 00 B. & S., at $300 per mile	3,000 00	
Erecting wire	100 00	
Belting and pulleys	100 00	
Cross arms, pins, insulators, etc	125 00	
Extra poles	150 00	
Setting same	50 00	
		$ 7,325 00
Total		$10,075 00

ADDITIONAL OPERATING EXPENSES.

Coal, 888 lbs. per night, or 162 tons per annum, at $2	$324 00	
Interest on $10,075 at 3½%	352 00	
Lamp renewals, sundry expenses, depreciation, etc	324 00	
		$ 1,000 00

COMMERCIAL LIGHTING AND POWER PLANT.

At the outset, Mr. Domville states that while the original cost of the installation of an incandescent and arc lighting and power plant for commercial purposes would be high, the city would be more than compensated for the same by the receipts from the sale of light and power. The principal addition to the power station would be the duplicating of the steam plant and the introduction of one alternator, one power generator and one arc dynamo, together with the necessary switchboards and connections. The principal outside item would be the cost of wire, transformers and additional poles required. The addition to the cost of operation would be coal, extra carbons, the employment of two men for indoor wiring, depreciation, and interest on bonds.

The cost of installation and operation of an incandescent and arc lighting and power plant of 3000 incandescent and 125 arc lights, for commercial purposes, in connection with the civic arc plant, is estimated as below:

COST OF INSTALLING INCANDESCENT AND ARC LIGHTING AND POWER PLANT FOR COMMERCIAL PURPOSES.

STEAM PLANT—		
One (1) 500 horse power tandem compound condensing engine and condensor erected and connected, ready for operation	$5,000 00	
Two (2) 212 horse power boilers, erected and connected ready for operation	7,700 00	
One boiler feed pump	300 00	
Contingencies	1,000 00	
		$14,000 00
ELECTRIC PLANT, INCANDESCENT—		
One (1) 150 kilowatt = 3,000 lights, alternator complete, with exciter and switchboard	$4,000 00	
Transformers of sufficient capacity for above	3,000 00	
Approximate cost of line wire, about 25 miles	9,000 00	
Extra poles	800 00	
Setting same	150 00	
Erecting wire, $10 per mile	250 00	
Belting and pulley	200 00	
Cross arms, pins, insulators, etc.	291 00	
		$17,691 00
ELECTRIC PLANT, ARC—		
One (1) self regulating series, arc lighting dynamo, 125 2,000 c.p. lights capacity	$2,750 00	
125 single carbon arc lamps with globes, at $15	1,875 00	
10 miles line No. 6 B. & S. weatherproof wire, at 16 cents per lb	800 00	
Insulators and pins	20 00	
Erecting wire, $10 per mile	100 00	
Pulley and belting	80 00	
		$ 5,625 00
ELECTRIC PLANT, POWER—		
One (1) 100 k.w. multipolar generator, complete with switchboard	$3,000 00	
Belting and pulley	200 00	
		3,200 00
Total		$40,516 00

ANNUAL COST OF OPERATING INCANDESCENT AND ARC LIGHTING AND POWER PLANT FOR COMMERCIAL PURPOSES.

Coal, incandescent plant, 3,555 lbs. per night, or 648 tons per year	$1,296 00	
Coal, arc plant, 2,135 lbs. per night, or 389 tons per year	778 00	
Coal, power plant, 7,110 lbs. per night, or 1,066 tons per year	2,132 00	
Carbons, 63 pair per night, 300 nights, at 1½ cents per pair	283 50	
2 men for indoor wiring, at $600	1,200 00	
Interest on $40,516 at 3½%	1,418 00	
Depreciation, 5% on $40,516	2,025 00	
Lamp renewals and sundries	200 00	
		$ 9,332 50

A rather unique application of electricity has been made at Sacramento, Cal. A Westinghouse alternating current induction motor of 2 h.p. capacity is direct connected to a centrifugal pump. The machines are operated from place to place in the operation of pumping wine from one vat to another. Receptacles for electrical connections are provided at convenient points throughout the winery, and the motor connected by means of flexible cable to the circuit of the Central California Electric Company, whose power is generated 30 miles distant. The motor has neither commutator nor brushes, and there is no connection between the revolving part and the electric current.

DEVELOPMENT OF WATER POWERS.

In the province of Quebec three projects to develop water powers for the generation of electricity have of late taken definite shape. The most extensive is at Shawenegan Falls, where it is proposed to utilize the water power of the St. Maurice river, at a point where there is a fall of 169 feet. Messrs. A. F. Gault and Mayor Prefontaine, of Montreal, together with other equally well-known capitalists, are the promoters. Tenders were recently invited for the excavation work, power house, etc., and it is understood that the contract has been awarded to Messrs. Barry, Ross & McRae, of Niagara Falls, Ont. The contract, which will occupy several months in completion, represents an amount between $300,000 and $400,000, but the total development, including machinery, will cost nearly one million dollars. The scheme also includes the building of an electric railway from Shawenegan Falls to Three Rivers, a distance of 19 miles, and the transmission of the power to the latter place.

The contracting firm of Barry, Ross & McRae are also engaged on the hydraulic work of a development scheme at St. Catharine, 16 miles from the city of Quebec. The promoters are chiefly New York capitalists, Mr. E. W. Cooke, of that city, being the general manager. The proposed point of utilization is a fall on Jacques Cartier river at the outlet of Lake St. Joseph. The company will enter the city of Quebec in the same way that the Lachine Rapids Co. entered Montreal. In both cities existing companies thought they had monopolies, but some years ago the Standard Electric Company was incorporated by the legislature with most extraordinary powers. One of them was that it could supply electricity to any plant in the province and make the constructions necessary for such purposes. The Standard charter was absorbed by the Lachine Company, which was thus enabled to defy opposition and enter Montreal. The Lachine Company, or rather the Standard Company, has now sold a similar privilege to the Jacques Cartier Company for the sum of $8,000, and the latter will be able to enter Quebec. The company also intends to utilize part of its power in the manufacture of pulp and paper, and to erect factories on the same scale as those erected by the Laurentide Pulp Company at Grand Mere, on the St. Maurice river.

The Canadian Electric Light Co., of which Mr. Wilson Smith, of Montreal, is president, will undertake the third project to which we refer, the Chaudiere Falls, near Quebec, being the point of development. It is proposed to light the town of Levis, to pump water for it from the St. Lawrence, to generate electric light for the cars of the Intercolonial and other railways at Levis, and to cross its wires into Quebec as well. It is estimated that the falls will give 5,000 horse power.

The Metropolitan Electrical Company of Ottawa, Limited, have made application to the Dominion government for a charter of incorporation. The capital stock of the company is placed at $500,000, and the provisional directors are: Thomas Lindsay, merchant, William Arnold and A. B. Broderick, of Ottawa, and James Robinson and Frederick Cains, of Montreal. It is proposed to engage in a general electric light and power business. The company are taking tenders on the supply of 4,000 poles. They have purchased a water power at Britannia from Mr. J. R. Booth. Mr. John Aylen, hydraulic engineer, has made an estimate of the water power available, which he gives as 40,000 horse power. Mr. Aylen will supervise the rebuilding of the dams, which he hopes to have completed by next spring.

MONTREAL.

(Correspondence of the CANADIAN ELECTRICAL NEWS.)

NEW ELECTRICAL EQUIPMENT AT MCGILL.

THANKS to the munificence of Mr. W. C. McDonald, who recently gave $30,000 for the purpose, the Electrical Department of McGill University is being newly equipped with thoroughly up-to-date electrical apparatus for experimental purposes. The new apparatus, most of which has already been purchased, will comprise the following :

One 100 h.p. high speed single cylinder side crank engine, 200 11 E. chloride cells, one m.p. 75 k.w. 125 volt direct current dynamo, one m. p. 30 k.w. 500 volt direct current dynamo, one m.p. 40 h.p. 125 volt direct current motor, two m.p. 25 h.p. 125 volt direct current motors, two m.p. 20 h.p. 125 volt direct current motors, two m.p. 15 h.p. 125 volt direct current motors, two m.p. 10 h.p. 125 volt direct current motors (the motors are compound wound, with shunt to series turns to vary degree of compounding, and with shunt rheostat to vary speed) ; one 6-pole 25 k.w. 220 volt revolving field A. C. generator, arranged to deliver single, two or three-phase currents, one two-phase 20 k.w. inductor alternator, one single phase 15 k.w. inductor alternator, two single phase induction motors, one 15 k.w. rotary convertor, one capacity set, one 10 h.p. induction motor, arranged to be used either as two or three-phase machine, with secondary provided with collector rings, so that motor can be used as frequency changer, three 3 k.w. potential regulators, two 5 k.w. 2-phase 3-phase transformers, one phase shifter, one 1 k.w. constant current transformer, five current transformers, one special transformer for A. C. ammeter testing, one 2 h.p. two-phase induction motor, one 200,000 volt testing set, one motor dynamo with double field for battery charging, one motor dynamo with double field for instrument calibration, two small synchronising motors, one electric welding outfit, one electric plating and typing outfit, four electric speed indicators, one laboratory standard volt-meter, one laboratory standard ammeter, one continuous rheostat, one potentiometer, ten standard cells, thirty volt-meters, ammeters and watt-meters, for general laboratory use, thermometers, one photometer and attachments, one conductivity bridge, two standard megohms, one standard condenser, one hysteresis tester, and various fittings and attachments.

The principal laboratories are : Dynamo laboratory, standardizing laboratory, laboratories for advanced investigation.

A 75 k.w. direct connected unit will be installed in the service plant for current supply, and a 75 k.w. hour storage battery in three sections in battery room, adjoining laboratory. There will be a distributing board for 36 circuits. It has been decided to abolish shafting in the dynamo laboratory ; every machine will have a separate motor for driving. None of the machines will be fixed permanently in place, but will be mounted on testing blocks, so that they may be readily moved from place to place, for which purpose the laboratory will be equipped with travelling cranes. The low voltage A. C. machines will supply two and three-phase current. Permanently wired testing tables will be used to facilitate work. The standardizing laboratory contains all instruments necessary for the accurate measurement of electrical and magnetic quantities. The new equipment is expected to be in working order on the re-opening of the school after the New Year vacation, although a longer period will be required to thoroughly complete the work.

Prof. Owens, who has recently been appointed head of this important department, has already shown himself to be possessed of a great deal of energy, and is setting a high standard for his department, which he will spare no effort to achieve. He has already arranged for visits of inspection by his students to some of the leading electrical manufactories and installations. A visit of this character was recently made to the Royal Electric Company's works and lighting stations in this city, and another will shortly be paid to the works of the Canadian General Electric Company at Peterborough, Ont. Following this, the power transmission works at Chambly and other important plants will be inspected. Great benefit must accrue to students who are thus brought in contact with the practical application of the science. It is understood to be the purpose to supplement this by a series of lectures during the coming winter by well-known electrical authorities. It is gratifying to learn that the attendance of third and fourth year students is double what it has been in former years.

LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

MR. Wallbank informs me that his company have just received the contract for lighting the city and suburban depets and workshops of the C. P. R., and that during the last month they have made contracts for upwards of 4,000 lights, including the new theatre on Guy street, which will be the first building to be served from an underground conduit connected with the terminals of the transmission line from Lachine.

ELECTRICITY IN COPPER MINING.

Experiments are to be made with a view to the introduction of electricity for lighting the copper mines of the Eustis Mining Co. These mines are situated at the town of Eustis, on the Boston and Maine Railroad, about a mile from Capleton, Que. The Eastern Townships Electric Light, Power & Carbide Co., who operate an electric plant at North Hatley, are already supplying light to the houses and other buildings at the mines, and, as stated, the company are negotiating with the company to light the mines also, for which purpose about 200 lights would be required. There is a difficulty in the way, however, which it is hoped may be overcome. In the mining of the copper, sulphuric acid gas is liberated, and its action upon electric wires and other metals is so destructive that unless means can be found for their protection the equipment would be rendered useless in a very short period. An iron smoke stack has had to be replaced by one of clay, owing to the action of the gas. In connection with the proposal to light the mines by electricity, experiments are about to be made with special forms of insulation which it is believed will suffice to protect the conductors.

NOTES.

The machine tools in the new workshops of the Central Quebec Railway, opposite Sherbrooke, Que., are to be operated by direct-connected electric motors.

The Chambly Manufacturing Company's power and light transmission plant is rapidly approaching completion. The generators are in working order, the transmission wires are being strung, and a transformer station is nearing completion at the Royal Electric Company's works on Queen street. The current will here be reduced from 12,000 to 2,000 volts.

Messrs. W. W. Gamwell and Henry E. Hine, president and general manager respectively of the Stanley Electric Manufacturing Co., of Pittsfield, Mass., were in Montreal last week. Accompanied by Mr. W. H. Browne, general manager of the Royal Electric Co., they visited Chambly and inspected the works of the Chambly Manufacturing Co. They afterwards spent a day in Quebec.

The Dominion Cotton Mills Company are now operating one department of their factory by electricity, a 250 h.p. motor being employed for the purpose. It is the intention ultimately to operate the whole of the works by electric power. Every precaution is being taken against fire, in view of the combustible nature of the manufacturing material. With this object, towers are being built separate from the main building, in which the motors will be installed. The electrical work is being carried out under the direction of Mr. P. G. Gossler, of the Royal Electric Co.

INSPECTION OF ELECTRICAL WORK IN WINNIPEG.

FOLLOWING is a copy of a by-law recently passed by the city of Winnipeg, Man., providing for the appointment of a city electrician and for the inspection and regulation of electrical apparatus :

INSPECTION AND REGULATION OF ELECTRICAL APPLIANCES.

There shall be an inspector of electrical installation and appliances for the city, who may be called the City Electrician, and until further or other appointment the chief of the fire brigade shall be such City Electrician.

ELECTRIC CURRENT.—No electric current shall be used for illumination, decoration, power or heating, except as hereinafter provided.

APPLICATION, CONTENTS, PERMITS.—All persons, firms or corporations desiring to install wires or other apparatus for the use of electric currents for any of the purposes mentioned in the preceding section of this by-law shall, before commencing or doing any electrical construction work of any kind whatever, either in installing new electrical apparatus or repairing apparatus already in use, file an application for a permit therefor with the City Electrician, which application shall describe in detail such material and apparatus as it is desired to use, with a full description of the same, giving the locality by the street and number ; and upon receipt of such application, if found proper, such permit shall be given.

DUTIES OF CITY ELECTRICIAN.—The said City Electrician shall then have power, and it shall be his duty when by him deemed necessary, to carefully inspect any such installation previous to and after its completion, and it shall be competent for him to remove any existing obstructions which may prevent a perfect inspection of the current carrying conductors such as laths, plastering, boarding or partitions ; and if such installation shall prove to have been constructed in accordance with the rules and requirements of the fire department of the city, and the rules and regulations forming part of this by-law, he shall issue a certificate of such inspection, which shall contain a general description of the installation and the date of such inspection. The use of electric current is hereby declared to be unlawful previous to the issuance of said certificate, provided however, the City Electrician may issue a temporary permit for the use of electrical current during the course of construction or alteration of buildings, which permit shall expire when the electrical apparatus for such building is fully installed.

Preliminary and Final Certificate.—A preliminary certificate may be issued by said City Electrician in the case of completed installations, but upon which no current will be used in the immediate future. Such preliminary certificate shall show that at the date of inspection the installation was erected in accordance with the terms of this by-law. Prior to the introduction of electric current into the said premises, a second inspection shall be made, when, if the said installation is still in accordance with the terms of this by-law, a complete and final certificate shall issue. Any owner or owners of property installing electric wires to be hidden from view shall, prior to such installation, give said City Electrician a reasonable notice in order to give ample time for inspection.

POWERS OF CITY ELECTRICIAN—PENALTY.

The said City Electrician is hereby empowered to inspect or reinspect all overhead, underground and interior wires and apparatus conducting electric current for light, heat or power, and when said conductors or apparatus are found to be unsafe to life or property, shall notify the persons, firms or corporations owning, using or operating them to place the same in a safe and secure condition within forty-eight hours. Any person, firm or corporation failing or refusing to repair, change or remove the same within forty-eight hours after the receipt of such notice, shall be liable to a penalty of $50.

Poles, Covers, Wires, Branded and Tagged.—All poles now standing or hereafter erected, and all covers for manholes now in service, or hereafter placed in service for the use of electric conductors, shall be branded or stamped with the name of the person, firm or corporation owning the same ; and all electric service entrances shall have attached to the conductor or conductors, in a conspicuous place, a substantial tag designating the owner of, and giving such a full description of the conductors as shall meet with the approval of said City Electrician.

Record, Annual Report.—It shall be the duty of the said City Electrician to keep records containing a full and accurate account of all inspections made and of all moneys received ; he shall annually on or before the first day of February in each year, prepare and present to the city council a report showing the entire work of his department during the previous calendar year ; and he shall at the same time send to the comptroller a full and comprehensive statement of all matters pertaining to his department, together with an estimate in detail of the appropriations required by the department during the next municipal year.

Alterations.—No alterations shall be made in any installation without first notifying the said City Electrician and submitting the same for similar inspection, as above provided.

Penalty.—Any person or persons who shall use electric current in violation of any of the provisions of this by-law shall be subject to a penalty of fifty dollars. Said City Electrician may for any violation of this by-law order and compel the cutting off and stopping such current until the provisions of this by-law are fully complied with.

The schedule of rules and regulations governing electrical work, as adopted by the Canadian Fire Underwriters Association, is also given as a part of the above by-law.

WIRELESS TRANSMISSION.

"The Electrical Transmission of Messages without Wires" was the subject of a lecture delivered before the Applied Science Society of McGill University, Montreal, recently by Professor Rutherford, McDonald Professor of Physics, who has done much original research along that line.

The subject, Professor Rutherford said, was still in its infancy, and it would probably be many years before it would be applied to practical use, if, indeed, it ever would be. Dealing with the history of the subject, he said that over twenty years ago Prof. Clark Maxwell pointed out the similitude existing between electrical vibrations and light waves. Prof. Hertz, of Bonn University, however, was the first to actually demonstrate the similarity of the two waves. Until Prof. Hertz's time, electrical waves were known to exist, but had not been detected ; he, however, in a wonderful series of experiments, detected these waves, and showed that in their behavior they acted exactly like light waves, except that they had a greater wave length. The lecturer then explained at some length the method used by Hertz to show the presence of these electrical vibrations.

From 1888 to 1894, he went on, much work was done with regard to electrical waves, and upwards of twenty different means of showing their existence were devised. Professor Lodge, in the course of experiments carried on in this direction, discovered that the passage of an electrical current between two knobs caused cohesion, and as a result of this discovery he devised what is known as the coherer, the most delicate means of detecting electrical vibrations.

Professor Rutherford then explained minutely the principle of the coherer, and successfully demonstrated its remarkable action by means of the light spot of a galvanometer. An instrument invented by the lecturer was next explained, in which fine steel wire took the place of the iron filings of the coherer, and acted by demagnetization. This instrument was so small that its entire length was not over one-third of an inch, and its thickness did not exceed that of an ordinary knitting needle. With this he had, in Cambridge, detected electrical vibrations at a distance of half a mile.

The more recent work of Marconi, a student of Bologna, was then dealt with. With the aid of Sir Wm. Preece, of the English post office, Marconi conducted an elaborate series of experiments, all based upon the use of the induction coil and coherer. By means of these he detected and recorded electrical vibrations at distances up to ten miles, and with very minute efficiency up to 20 miles.

By means of a decoherer, such as an electrical hammer, the recording of these vibrations could be used as a telegraphic code, and this is all that has so far been achieved in the matter. In conclusion, Prof. Rutherford dealt with the future possibilities of electrical transmission without wires. He thought that ten miles, the distance achieved by Marconi, was in all probability the limit, as the distance through which the waves can be detected is very much in proportion to the size of apparatus used, and Marconi is now using the largest instrument possible. As there has not, so far, been devised any means of controlling the vibrations, which must be sent out in every direction, messages sent must be, in a measure, public property. It is, nevertheless, possible that a reflector may yet be devised, which will act for the electric wave in the same way that the parabolic mirror does for light waves. In the case of electrical vibration, however, the mirror would have to be carried out on a very much larger scale.

A discussion followed the lecture, and was joined in by some of the professors and students present. During this, the blowing up of the powder magazines of warships by means of an electrical wave was referred to. Professor Rutherford reassured his audience upon this most interesting point, by stating that he did not think it possible that an electric wave could penetrate a properly closed vessel.

A donation of $30,000 is said to have been made recently by Mr. W. C. McDonald to the Department of Electrical Engineering at McGill University, Montreal.

ENGINEERING PLANT IN FREEHOLD LOAN COMPANY'S BUILDING.

One of the largest and most modern office buildings in Canada is that of the Freehold Loan and Savings Company, corner Victoria and Adelaide streets, Toronto, the engineering plant in which is under the superintendence of Mr. James Huggett. A few particulars of this plant, as gleaned from a personal inspection, may be interesting. The building is lighted by electricity, but gas may also be used if necessary. It is said that the wiring of the building for electric lighting cost upwards of $4,000. The elevators are hydraulic, of improved design, and the best that could be purchased, being capable of operating at a speed of 700 feet per minute, but the usual speed is scarcely above 450 feet per minute. The elevators, boilers, pumps, plumbing, steam heating, etc., cost in the neighborhood of $50,000, the Bennett & Wright Company being the contractors for plumbing and steam fitting.

All power is generated on the premises, the boiler capacity being capable of developing 200 horse power. Both water tube and tubular boilers are used. These are so arranged as to heat the building by low pressure, at the same time carrying high pressure for power purposes. The exhaust steam is used for heating the building, and returns are controlled and pumped back to the boilers. There are seven steam pumps, of all sizes, from 22 gallons to 500 gallons capacity per minute, manufactured by the Northey Company, of Toronto; one large compound pump weighing five tons. The capacity of the pumping plant for elevators alone is nearly three-quarters of a million gallons per day. There is an auxiliary pump for elevator service, which is used for heavy lifts. Smaller pumps are provided for other purposes, including an air pump in connection with temperature regulation. The temperature in each room is regulated by what is known as the Johnson electric air pressure controller, having thermostat in each room and diaphragm over each end of radiator to control the valves, which has been found to be a great convenience to tenants. This system is controlled from the boiler room, where electric batteries, air pump, etc., are placed, and in the hands of the present superintendent has been a complete success. All water is filtered by a large filter with a capacity of 200,000 gallons per day, and hot water is supplied to all parts of the building.

Mr. James Huggett.

The building is heated by steam by direct and indirect radiation, both systems being controlled. The ventilation of the building appears to be first-class, the method adopted being to bring in fresh air and take out foul air by a large fan placed on roof and operated by steam power. Fire protection is also provided by a stand-pipe and branches on each floor, with hose to reach to any part of the building, while a fire brigade, well drilled, reduces the danger of fire to a minimum. The fire system has also been connected with the pressure tank at top of building, so that at any time the large pumps in the basement may be started, thus, in case of fire, providing greater pressure than can be obtained from the city water service.

Mr. James Huggett, the chief engineer, whose portrait we present, has had charge of this plant since it was installed, and, by the aid of his assistants, keeps the building and equipment in first-class condition. Indeed, the general appearance of the building is often favorably commented upon by visitors. Mr. Huggett, for a number of years, has been a member of the Canadian Association of Stationary Engineers, and for some time past chairman of the Trustee Board. For three successive years he has been elected a delegate to the annual convention, showing the esteem in which he is held by his brother engineers. He was born in Chatham, Kent, England, where he obtained his first engineering experience, at the Naval Dock Yard. He has resided in Canada for the past twenty-eight years, during which time he has gained much practical experience. Before coming to Toronto to accept his present position, Mr. Huggett was for fifteen years in the employ of the A. S. Whiting Mfg. Company, of Oshawa. His present duties include the general superintendence of the building as well as of the engineering plant, and he has proved himself to be the right man in the right place.

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 5.00	P.M. 9.00	4.00
2....	" 5.00	" 9.40	4.40
3....	" 5.00	" 10.50	5.50
4....	" 5.00	" 11.50	6.50
5....	" 5.00	A.M. 12.50	7.50
6....	" 5.00	" 1.50	8.50
7....	" 5.00	" 3.00	10.00
8....	" 5.00	" 4.00	11.00
9....	" 5.00	" 5.00	12.00
10....	" 5.00	" 6.00	13.00
11....	" 5.00	" 6.20	13.20
12....	" 5.00	" 6.20	13.20
13....	" 5.00	" 6.20	13.20
14....	" 5.00	" 6.20	13.20
15....	" 6.20	" 6.20	12.00
16....	" 7.40	" 6.20	10.40
17 ...	" 8.50	" 6.20	9.30
18....	" 9.50	" 6.20	8.30
19....	" 11.00	" 6.20	7.20
20....	" 11.00	" 6.20	7.10
21....	" 11.40	" 6.20	6.40
22....	" 5.00	" 6.20	13.20
23....	" 5.00	" 6.20	13.20
24....	" 5.00	" 6.20	13.20
25....	No Light.	No Light.	.....
26....	No Light.	No Light.	.....
27....	No Light.	No Light.	.....
28....	No Light.	No Light.	.....
29....	P.M. 5.10	P.M. 10.00	4.50
30....	" 5.10	" 10.00	4.50
31....	" 5.10	" 10.00	4.50

Total.......... 253.40
Grand Total...2208.00

The Canadian General Electric Company have sold an electric plant to the Oxford Mfg. Co., of Oxford, N.S.

MACHINERY BEARINGS.

Any mechanic will inform you that the common plummer-block should be a little easy at the sides, and that the bearing should receive oil from the top. He seldom knows the reason for this rule, however, and though his ignorance does not prevent his mill shaft bearings running cool, not "knowing why" makes him experience trouble with many bearings not so simply loaded.

John Dewrance, in a paper on the subject, detailed experiments which ought to clear ideas and rectify erroneous practices.

Bearings were clamped upon a shaft so that the load upon its underside was this same clamping pressure, while on the top this was augmented by weight of brasses, clamps and springs.

An oil hole at the top refused entirely entry to oil, which could be given, however, at either side. The bearing—which ran fairly cool—ejected oil under a pressure of 2,300 lbs. per square inch through the upper oil hole. The bearing was then taken out and surface dressed in order to obtain still greater pressures; but when replaced, instead of this great positive ejecting pressure, there was a suction at the upper oil hole measured by a vacuum gauge at thirty inches; the whole still running cool and well. The blocks when taken out showed at first sight no explanation for so great a change in pressure, but close examination made the matter clear. The under side of the top brass at first was not quite flat, the central portion taking all the load; this sprung the brass and ground the central part; so, when replaced under diminished load, there was a vacant space around the oil hole, where formerly had been the greatest pressure.

In any bearing to run cool and well means that a film of oil keeps forcibly apart the sliding pieces. The total pressure on this oil must be the total load. The surface tension of the oil and capillarity alone provide the power the oil has to resist this pressure, therefore the pressure is the greatest where space between the surfaces is least. And since, moreover, oil is carried on by sliding, it follows that to keep up the supply the space must taper to the point of greatest pressure.

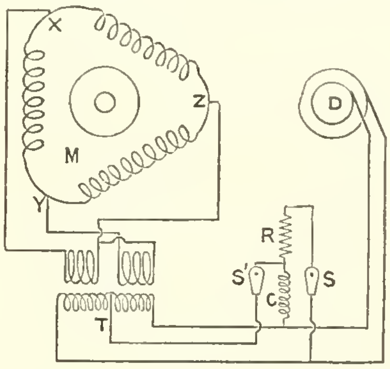
If we lay a flat plate on a well oiled shaft, and gauge the pressure at a hole drilled through it, as we approach the point of nearest contact pressure will rise, to fall again—and fall down below zero as we pass it.

Tapering spaces must then be provided in all our bearings of this class; and oil supplied at that point where the load is least. The series of experiments referred to was first taken up in order to discover whether "brasses" of different metals differed in their capacity for bearing loads without increase or friction. As one might have anticipated, it was found that no such difference existed; so long as a sufficient film of oil remains it matters little—in this connection—what the metals are. Given that they are strong and stiff enough the one great point is that the bearing should be softer than the shaft; for then at times of failure in the oiling the shaft is coated with the scraped-off softer metal, more or less evenly around its surface. But if the shaft should be the softer of the two, its heaped-up scraping will accentuate local unevenness in the bearing.

The main point in the paper is, however, the light thrown on the simple point of oiling. In ordinary mill shaft plummer blocks this is done rightly from the top. At first our railway axle bearings were likewise—but wrongly—fed; that fault was soon detected and set right; but still mechanics' ignorance upon the subject causes much trouble with some engine bearings; and since it is a fact that pressures over one ton per square inch can be endured by properly constructed brasses, while costly troubles are often caused by far less loads, the question certainly deserves attention until our errors are set right.

PHASE TRANSFORMERS.

The usefulness of some simple form of phase transformer enabling single-phase currents to be split up into polyphase currents, and thus permitting the use of a simple conducting system of one wire, would be especially appreciated in the field of railway work, where any attempt to use polyphase currents for power purposes is met at the outset with the difficulty of a double trolley system. In a very valuable paper in Zeitschrift fur Elektrotechnic, Herr Gustav W. Meyer discusses all the forms of phase transformers, with special reference to this application. An ingenious device for operating a three-phase motor on a single-phase current supply is illustrated above. The motor, M, has the usual field winding and a three-phase winding on its rotor. The stator is connected as shown to the two ends and the middle point of the secondary of an ordinary split transformer, and in the primary circuit with this is connected a non-inductive resistance, R, and a self-induction coil, C, as shown. By the switches, S and S^1, these can be cut in or out of the circuit. At starting they are cut in, as shown, and produce a sufficient displacement of phase to start the motor. After the motor attains speed the switches are opened, and the reaction of the three-phase winding on the rotor induces a current in the part X Y of the stator winding, the machine continuing to run as a three-phase motor, though supplied with single-phase current. The American Electrician says that it is claimed that this method surpasses the rotary phase transformer of Arno and Ferraris, on account of its simplicity and cheapness and absence of moving parts.



RECENT CANADIAN PATENTS.

Patents for the following electrical and engineering devices have been granted in Canada: A. F. Hack, Melbourne, Aus., steam boiler furnace arch; American Electric Heater Co., Detroit, Mich., electric heater; M. E. Thompson, Ridgeway, Penn., and Charles L. Cornell, Hamilton, Ohio, dynamo electric machine; Theophilus D. Farrell, London, Eng., electric lamp; Philip H. Patriarche, Toronto, street annunciator for cars; John F. Lister and Wm. S. Chamberlain, Cleveland, Ohio, incandescent lamp; Charles M. Gould, assignee of Wm. F. Richards, Buffalo, electric lighting apparatus for railways; Electrical Vehicle Syndicate, London, Eng., electric carriage safety device; Charles T. Monroe, Silas C. Dishno and Narcisse Deloge, Jackson, Montana, water wheel; O. H. Michaelson, Charleston, U.S., electric lamp; Alex. H. Canning, Toronto, rotary engine; Geo. M. Lane and Elisha Stout, electric arc lamp; John Abell, Toronto, engine cut-off.

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Appointment of City Electricians.

ELECTRICAL companies will welcome the growing disposition on the part of municipal authorities to appoint properly qualified electricians to protect the interests of municipalities in the matter of electric wiring and other electrical work. The municipalities are realizing that this course is, in the end, the most economical, while encouragement is also being given by the electrical companies, who will no longer be called upon to execute unnecessary work, as is often the case when the decision of an incompetent and inexperienced person is allowed to govern work of this description.

Efficiency of Coals.

A REPORT on the steam-making value of coals has been issued by the Boston Mutual Boiler Insurance Company, by which it is shown that a large quantity of stone and dirt is mixed with nearly every variety of coal, thus reducing its efficiency. Tests of samples of coal as delivered by dealers showed proportions of earthy and stony matter varying from one and one-half to forty-six per cent. Taking the principal varieties of coal as burned in the Eastern States, the consulting engineer of the company found that, rating the evaporative power of Cumberland coal at one hundred as the standard, the comparisons were as follows: Pocahontas coal, 102; Clearfield, Wyoming, New River and Lykens Valley coal, 97 to 98; Schuylkill, 95; Lehigh, 93; Nova Scotia, 85. The average percentage of ash was: New River, 5½ per cent.; Cumberland and Pocahontas, 7½ per cent.; Clearfield and Nova Scotia, 10 per cent.; other qualities, from 15 to 18 per cent. The anthracite coals were found to be much less clean than the soft coals. Subtracting the ash, so as to compare results for the combustible portion of the coal, there is little difference between the heating power of the various classes, the

Nova Scotia—the lowest on the list—rating only a trifle below Lehigh, and but ten per cent. below Cumberland and Pocahontas, which are the highest. As the cost of shovelling coal into a furnace, and of removing ashes and cinders, is an item of considerable expense in operating a steam plant, it becomes the duty of the manager thereof to give strict attention to the quality of coal burned.

Electrical Water Power Developments.

If indications count for anything, the utilization of water powers for the development of electricity is only in its infancy in Canada. Recent years have witnessed the harnessing, for electrical purposes, of several large water powers, while in some instances skilful engineering has permitted of comparatively small water powers being used, under a high pressure, to develop a considerable output of current. These conditions, so widespread throughout Canada, would, as stated, indicate their future utilization on a large scale. The extent of this development will depend, almost entirely, upon the demand for electricity for light, heat and power purposes. As to the former, there are numerous municipalities which would, without doubt, welcome the advent of electric light, but which are too small to support a private company. This business might be secured, with profit, by a company operating long distance circuits and supplying a number of municipalities. For heating purposes the use of electricity is steadily increasing, but being looked upon as an innovation, we do not anticipate an immediate extensive demand for its use. It is in the direction of furnishing power for manufacturing establishments that we look for the widest field for electrical transmission plants. Canada is becoming more and more of a manufacturing country, and capitalists are being attracted here as a promising field for investment. The number of water power development projects that have already taken definite form is in itself significant. The most important is at Shawenegan Falls, Que., where the water of the St. Maurice river is to be utilized to develop 30,000 horse power to operate pulp mills, saw mills, factories, etc., at Three Rivers and other places. Near the city of Quebec there are two projects to be carried out, on one of which work is now progressing. At Port Arthur, Ont., Mr. E. S. Jenison is negotiating, with good prospects of success, for the development of the water power of the Kakabeka Falls, on the Kaministiquia river, and transmitting the electricity to Port Arthur and Fort William, at an estimated cost of one million dollars. Similar undertakings are contemplated at Grand Falls, N.B., and in British Columbia, all of which bear testimony to the improved conditions now prevailing in Canada.

CANADIAN ELECTRICAL NEWS STUDENTS' COMPETITION.

In pursuance of the preliminary notice published last month, we had hoped to be able to announce in this number full particulars of the competition which the publishers of this journal propose to institute among the electrical students in Canadian colleges. While progress has been made with the details, it has been found impossible to complete all the arrangements, and we must ask readers who may be interested to await the publication of our December number, in which the terms of the competition will be fully explained.

HAMILTON ELECTRIC LIGHTING REPORT.

Particulars of the report of Mr. Percy Domville to the council of the city of Hamilton, as to the cost of lighting the city by a plant to be owned and operated by the corporation, are given elsewhere in this number. The report goes pretty fully into the various items which enter into the determination of these costs, with the result that the citizens of Hamilton are assured of their lighting being done for $54.55 per 2000 c.p. lamp per year for all night running. It may be of interest to refer to some of the salient features of the report. Looking at the figures, we are interested in knowing that one 500 h.p. tandem compound condensing engine, with condenser, is to be used, and can be erected and connected in running order, with foundations complete, for $5,000, and to be of such a superior type, apparently, as to obviate all chances of breakdown, as no allowance is made for another engine to cope with such an emergency. The simplicity and cheapness of this single unit and faith system will appeal to the average station manager whose contract depends upon the ability of his plant to keep the lights running every night and all night.

It will be observed that in the operating expenses the largest item is that for coal, which can be laid down at the furnace doors apparently for two dollars per ton, which it is probably worth, as we are assured that one pound will give 140 watt hours at the lamp, with four pounds consumption per h.p. and with 90 per cent. efficiency in engine and arc dynamos, and 93 per cent. in line. The experienced station manager, accepting the coal consumption given, would figure about as follows: Engine, 90 per cent. efficiency; arc dynamos, 88 per cent. (that being the maximum claim made by the makers); countershaft efficiency, 90 per cent.; belting, 95 per cent.; line, 93 per cent. as before. This gives 118 watts per pound, instead of 140, increasing the coal consumption by 15 per cent. The experienced manager would also make an allowance of about 10 per cent. for banking or starting fires and to cover shrinkage in the coal pile, all of which he has to pay for, thus increasing the coal cost by 25 per cent.

The next largest item is depreciation, at 5 per cent. We welcome this figure as indicating a recognition of the fact that depreciation of a municipal plant does exist, it being frequently omitted altogether in such reports. As no other allowances are made, we infer that this five per cent. is intended to cover repairs, antiquation and possibly insurance, as well as the depreciation due to gradual wearing out. Most authorities would consider that 5 per cent. on buildings, 7 per cent. on steam machinery, and 10 per cent. on electrical apparatus, pole lines, etc., would be a very modest estimate to cover these items, which are placed by Mr. Domville at 5 per cent., and to be safe they would figure interest and depreciation on extra engine in case of trouble. Considering only these three items of cost, coal consumption, depreciation and an extra engine as above indicated, we find that the cost per lamp has gone up from $54.55 to $64.30. We need scarcely enquire further into the costs, the unreliability of the above items indicating what may be expected of the others. We observe, however, that no allowance is made for stock of coal, wire, poles, extra lamps, etc., which must be kept on hand, nor for meters, transformer erection, and many other items which appear against the capital account of the ordinary station. The solitary dynamo tender provided for in the estimates has our sympathy. He will have on his hands the complete responsibility of the operation of a five hundred light plant. His shift will be 10 hours long during the winter months, for seven days per week, and presumably he will have to spend a portion of the remaining eight hours of the 24 in adjusting and making small repairs to the machines in his charge. We think that services of this kind merit more reward than $600 per year.

Seriously, we hope, for the reputation of all concerned, that the Hamilton authorities will look more carefully into the matter, and not be led to expect impossibilities, even when backed up by nicely arranged figures. This report is typical of that class of statements by means of which municipalities have been induced to undertake responsibilities with which they were not familiar, and frequently with disastrous results. In drawing up a report of this kind, it is comparatively easy to figure the cost of a system ready to run, but it requires a thorough knowledge of operating conditions to predict with any certainty the operating costs, and, as in this case, it is in this respect that many such reports are unreliable. We do not wish to be understood as condemning every case of municipal control off-hand, but we do say that in the majority of cases it has been found to be a mistake. Given the same system under municipal and under private control, and assuming that the management in both cases has the same dividend making efficiency, the former will have an advantage, for whereas the municipal plant is capitalized on money borrowed at 3.5 per cent., the private plant is expected to pay, say, 8 per cent., and the difference of 4.5 per cent. is in favor of the first. Again, a new municpal plant properly engineered and managed, has, by reason of its greater efficiency of operation, a decided advantage over an old and inefficient plant which it is to replace ; but old age comes to even the municipal plant, and in ten or fifteen years consigns it to the scrap heap, and depreciation to correspond must be allowed. In any case, the difference in cost of operation will not be so great but that by improper management the positions may be reversed, and municipal management, hampered as it usually is by local politics, is not in the best position to make the most of the above advantages. It is to be hoped that before taking action upon the report the authorities of Hamilton will submit it to competent criticism.

THE OLDEST STEAM ENGINE.

The oldest engine in the world is in the possession of the Birmingham Canal Navigations in England, and was constructed by Bolton & Watt in the year 1777, the order being entered in the firm's books in that year as a single acting beam engine, with chains at each end of a wood beam, and having the steam cylinder 32 inches in diameter, with a stroke of 8 feet, and erected at the canal company's pumping station at Rolfe street, Smethwick. During the present year this remarkable old engine, which has been regularly at work from the time of its erection to the current year, a period of, say, 120 years, was removed to the canal company's station at Ocker Hill, Tipton, there to be re-erected and preserved as a relic of what can be done by good management when dealing with machinery of undoubted quality. It is worthy of note that the Birmingham Canal Navigations favored Bolton & Watt, in 1777, with the order for this engine, and, in 1898, or 120 years afterward, the company have entrusted the same firm, James Watt & Co., Soho, Smethwick, with the manufacture of two of their modern triple expansion, vertical engines, to be erected at the Walsall pumping station, having 240 horse power and a pumping capacity of 12,713,600 gallons per day.

TRANSMISSION SCHEME AT GRAND VALLEY.

The opening of a thirteen mile transmission line for electric lighting purposes only between Grand Valley and Arthur, Ontario, marks a new era in electric lighting in Canada. The village of Grand Valley is situated on the Canadian Pacific railway, about 100 miles from Toronto, and has a population of 800 people. The residents of this village desired electric lighting, but the municipality was rather small for the investment to be made for electric lighting only. However, Mr. John Philip, who owns and operates a saw mill at Grand Valley, was enterprising enough to give the people incandescent electric lights. For this purpose he installed in his saw mill an S.K.C. two-phase generator with a capacity of about 750 or 800 incandescent lamps. He found that after supplying the wants of Grand Valley, he still had a capacity to spare on his dynamo, engine and boiler of about 400 lights, and as the electric lighting at Grand Valley was not sufficient to pay him a fair income on the money investsd, he cast about for other means of utilizing the current. He consulted one of the engineers of the Royal Electric Company, who suggested the idea of transmitting the current from one phase of his machine to the village of Arthur, about 13 miles distant, and using the other phase for the lighting of Grand Valley.

When the scheme was mooted and the people of Arthur approached on the subject, they were willing to fall in with the idea, but were very doubtful if the current could be carried that distance ; in fact, some electricians laughed at the idea. Nevertheless, Mr. Philip being a sturdy Scotchman, and having confidence in his advisers, undertook the work, and on the evening of October 20th the lights were turned on in the village of Arthur, and have been in operation since that time.

The entire loss in the transmission is said to be less than 5 per cent., and the lights are equally as good in Arthur as they are in Grand Valley, close to the machine. In this way Mr. Philip has converted a non-earning property into one which will in future pay him a handsome sum.

There are many existing plants in Ontario now which could, in the same manner, increase their revenue, and we would commend this installation to their careful consideration. The conception and carrying out of this work is certainly a credit to the Royal Electric Company, and doubly so to the person who was willing to invest his money in an enterprise when he was advised that the scheme was not feasible. He certainly deserves to be classed in the front rank of central station men in Canada.

Rev. Father Quay, of Gracefield, Que., has shipped five tons o amber colored mica to the United States, to be used for electrical purposes.

NOTES ON BELTING.

Tests of Leather, Rubber, Cotton and Other Belts.

By G. R. MacLeod, McGill College, Montreal.

For transmission of power by belting various materials are used. Among the most important are: Leather, rubber and cotton belts.

The material considered most favorable for belting is probably leather. It is very efficient and wears well, but is more expensive than rubber or cotton. In certain situations where it would be exposed to moisture, great heat, etc., its efficiency and durability are reduced.

Another weakness is that it must necessarily consist of short strips of about five feet in length, joined in various ways, which will be noticed later. The belt is therefore subject to failure in as many places as there are joints. Some methods, however, make the joints almost as strong as the solid leather, but the presence of the joint may cause the belt to fail, not from tension, but from a tendency to wear or crack at that point.

The best belts are made from oak-tanned ox-hide, the strongest part of the hide being the back. The belt can be made in long strips by taking a wide disc of leather and cutting it in a spiral direction. The strip thus cut is stretched taut and rubbed to make it straight. From a disc 4 ft. 9 in. wide a strip over 100 feet long of 2 inch belt can be made. If greater width is desired several strips can be sewn together side by side. A double belt of this kind has been used 75 inches wide and over 150 feet long.

The grain or hair side of the leather is put next the pulley. It would appear at first sight as if this were a mistake, since the grain side is the smoother and would therefore give less friction. Mr. Arthur Archard, of Geneva, in a paper before the Institute of Mechanical Engineers, 1881, says:

"If the belt is wide, a partial vacuum is produced between the belt and the rim of the pulley, by the aid of an adequate velocity which causes the atmospheric pressure to press the belt close against the pulley; an adhesion is thereby produced which is totally independent of friction, and enables the tensions to be considerably reduced." This is very important, because the less the tension on the belt, the less will be the friction on bearings, and, hence, the greater power derived. A wide, thin belt is therefore better than a narrow, thick one, and this is so not only for the reason that it gives less tension on the belt, but because it also gives greater flexibility.

Mr. D. A. Low, in his Machine Designing, also states that the smooth side is the better "because it gives greater driving power," reasoning probably in the same way as Mr. Achard.

Mr. J. Tullis, of Glasgow, however, states that the belt will last longer if the grain side is out, and that coatings of curriers' dubbin and oil will make the flesh side as smooth as the other. All writers seem to agree that the adhesion of the belt to the pulley depends very little, if any, on friction, and that, therefore, a rough surface is more injurious than useful.

Rubber belting is superior to leather in damp places. The part of the belt that gives it strength is not the rubber, but the cotton framework.

It is made by taking a wide strip of cotton duck and folding it into as many plies as desired, with rubber in between, with a thicker coating of rubber on the outer side.

The rubber is in a liquid state when applied to the cotton, and when the belt is finished it consists of a strong, solid, flexible belt, having the appearance of solid rubber. There is almost no limit to the length that can be made in one piece, so that there is only one joint in any piece of belt in use. Even this can be avoided by ordering an endless belt for special cases. The manufactured product is usually very uniform in quality. Extremes of heat and cold have very little effect on it, and it has very little tendency to slip on the pulley. It should be kept free from all animal oils or grease, as these are injurious to the rubber. Rubber belting seems to be especially adapted for such purposes as elevators, for railways, pulp mills, mines, etc.

Cotton, that is cotton without rubber or any other material, makes an excellent belt. In can be made stronger than leather of the same cross-section, and of great length without joints. It is better than leather in moist places, and is less expensive. It was formerly made in the same way as cotton and rubber belting—that is, by laying one ply of cotton duck on top of another till the desired thickness was attained, and then sewing the whole together. The more modern method is to make the whole thickness together at one operation, each ply being interwoven with the one next to it. The process of manufacture is rather complicated, but this does not make the belt expensive.

An improvement on the plain cotton belt is made by soaking it in a mixture of red lead and linseed oil. This process has the same effect as it has in preserving wood. The cotton belt is then more efficient in moist places or in conditions which are found very unfavorable to the use of leather or even rubber. Some modifications of this kind of belt are made by substituting for part of the cotton a woof of hair and other materials. An example of this is the "Camel Brand," tests of which are reported below.

Gutta percha has been used as a substitute for rubber, and has been found to be a good protection to the cotton. A special brand of this, called "Balata Belting," was tested. It is manufactured in England, and has a rather thick coating of gutta percha on the outer side, and thin layers between the layers of cotton, while the side next the pulley is coated with a solution called "Balata."

STRESSES IN BELTS.

Belts are subject to two kinds of stress, viz., tension and bending, but the most serious strain is caused by bending round the pulleys. If the pulleys are small, the only way is to use the most flexible material. This will probably be the cheapest in the long run.

A good rule is given by Lineham in his Mechanical Engineering, viz., the distance from centre to centre of pulleys should not be less than six times the diameter of the larger pulley.

A most important matter is that the edges of the belt should wear well. If the edge is not good it will soon become frayed by contact with the rim of the pulley, and will cause failure of the belt. The best edges that the writer has seen on any belt are on good oak tan leather, and on rubber. The structure of the latter (folding), together with a strong covering of rubber, secures a good, compact edge.

Belts of paper have been made and used in the United States with success. They are very strong and durable if not exposed to moisture, and they stretch very little while at work.

So far nothing has been said with regard to stretch of belts under tension. This will be treated along with the results of the tests.

Creep in belts is due to the belt stretching on the tight side. If the belt stretches easily this is very serious. For every foot of belt that goes on the driver less than a foot goes off and goes on to the follower. If the diameters of the pulleys were equal the driver would make a greater number of revolutions in unit time than the follower would. Hence, if there is much stretch in the belt there is a loss of speed. This loss amounts to 1 per cent. to 3 per cent., depending on the elasticity of the belt; since the tension on the belt is kept as low as possible to prevent too much friction on bearings of the pulleys, the belt that is least extensible at low tensions is the one which is most valuable in this respect.

JOINTS AND FASTENINGS.

Joints form the weak feature of belts, so far as tensile strength and wear are concerned, especially in the case of leather belting. They are of two kinds, (a) permanent, (b) temporary.

Permanent joints take many different forms. In leather belting the most common is the laced joint (Fig. 1.) A lap-joint splice is made and cemented together; then two or three rows of rawhide lacing is put in. The holes for the lacing are not punched, but two sharp cuts are made for each stitch. The cuts should lie diagonally so as to injure the longitudinal fibres as little as possible.

Copper riveting is used as a substitute for lacing, the belt being spliced, as before, and a number of rivets inserted (Fig. 2.) This joint shows a tendency to break across a row of rivets, and is only about two-thirds the strength of the solid belt.

Harris metal plate fastener (Fig. 3) consists of a slightly curved plate, same width as the belt, with a number of spikes. The belt is cut with square ends, and the spikes are driven first through one piece and then the other. As the plate is curved and the spikes are perpendicular to it, they take a good firm grip on the leather. The spikes are clinched after connection.

In Lagrelle's fastener (Fig. 4) the ends of the belt are cut square and bent up. Strips of steel or iron are run through the holes cut for the purpose, each strip having two eyes to hold pins. These pins run through strips at each end, and form a wide link. In fasteners such as this the strain is distributed over the width of the belt, and there is also not the same tendency to cut through in front of the holes as in many other kinds.

TEMPORARY FASTENINGS.

The fastener shown in the accompanying sketch (Fig. 5) consists of a curved strip of iron. The ends of the belt are cut square and holes are made to receive the fastenings, which are inserted and hammered flat.

Laced Joints. There are many forms of laced joints. The simplest is shown in Fig. 6.

Fig. 7 is the same joint as Fig. 6, but double laced.

Fig. 8 is a double laced joint with only one strand in each hole.

In the joint shown in Fig. 9 the holes are staggered; there is only one strand in each hole, and the strands do not cross on each other.

These are the commonest forms. Fig. 6 has hardly enough lacing; Fig. 7 has twice as much lacing as Fig. 6, but concentrates all the stress on a single row of holes. Joints like Fig. 8 and Fig. 9 give about the greatest possible strength of lacing.

The holes for the lacing are usually round punched. Awl holes are not so good. D. A. Low, Machine Designing, says that the holes should be oval punched, and should have the long diameter parallel to the edges of the belt. And on the face next the pulley the lacing should be as nearly parallel to the edge as possible. It is also better if the lacing does not cross on itself.

Double belting, generally speaking, is not so good as single, since flexibility is what is required. It has been found, however, in certain cases, such as the belt for a return saw, that a double belt wears best, being better able to stand the alternate stretching and buckling.

RESULTS OF TESTS.

Tests of belting were made in McGill College testing laboratory in 1896-7 on the Emery testing machine. When pressure from the accumulator is admitted gradually the diagram curve of extensions is quite smooth and regular, but when the machine is fed rapidly the extensions are less; this becomes more noticeable in belt testing. It shows as a sharp change in the curve, but when the feed is again better regulated the curve resumes its former course. In some cases these sharp changes in the curve may be due to lack of uniformity in the material, particularly in the case of belting composed of cotton and hair. Extensions were read at every 200 pounds increase of load, except in some of the larger specimens, where readings were taken every 500 pounds increase.

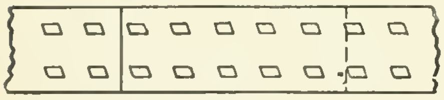


FIG. 1.

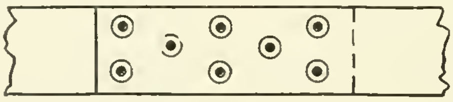


FIG. 2.

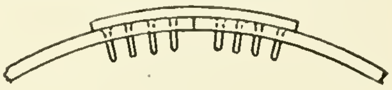


FIG. 3.

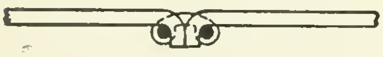


FIG. 4.

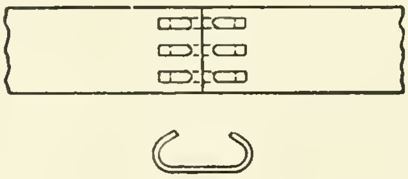


FIG. 5.

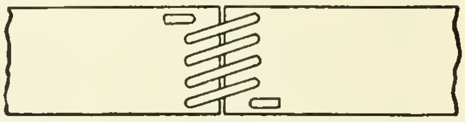


FIG. 6.

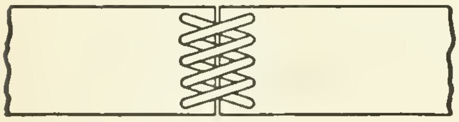


FIG. 7.

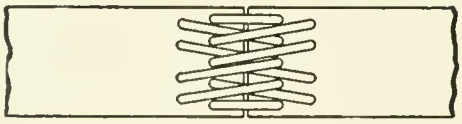


FIG. 8.

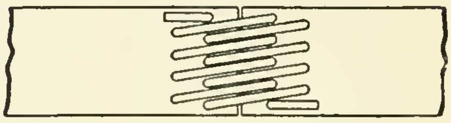


FIG. 9.

Leather Belting. Specimens were procured from a dealer in Montreal.

NO. 1.—ENGLISH OAK TAN LEATHER.

Width, 2 in. Sectional area, .453 square in.
Weight, .213 lb. per lineal foot.
Cost, 23 cents per ft.
Total stretch in 24 in. was 2.15 in. = 9 per cent.
Permanent stretch, 0.2 per cent.
Maximum strength, 2,210 lbs. per square in.

This specimen contained a spliced cemented joint and laced in the same manner as first example described under "Joints." It broke straight across the middle of the joint.

NO. 2.—(Same belt as No. 1, but without joint.)

Maximum strength, 4,640 lbs. per square in.

This shows that the strength of the joint is about one-half the strength of the solid belt.

NO. 3.—HEMLOCK TAN LEATHER.

Width, 3½ in.
Sectional area, .798 square in.
Weight, .206 lbs. per ft.
Cost, 43 cents per ft.
Total extension was 3.11 in. in 18 in. = 18.3 per cent.

This specimen has a cement splice without lace or rivets. It failed at 3,300 pounds per square inch.

Fracture took place, not in joint, but immediately at its edge.

A solid piece of this belt stood 4,000 pounds per square inch.

An unlaced cemented joint is stronger than a laced one, but lacing is necessary where the belt is exposed to heat or moisture.

RUBBER BELTING.

The specimens tested were manufactured by a Canadian company.

The curve of extensions is almost a straight line with a slight tendency to turn upwards immediately before fracture. This straight line indicates that the extensions are about the same for each increment of load, and hence that the material is very uniform. Another fact that shows the uniformity of the material is that the fracture in each case was clear and straight across the belt. It was not a tear but a break.

The method of measuring the extensions is shown by Fig. 10. Two pencil lines are ruled square across the belt exactly thirty inches apart. A scale graduated to hundreths of an inch is clamped with one end at the lower mark.

A long steel pointer is clamped at the other mark. As the belt stretches this pointer moves along the scale, thus giving the amount of stretch, which can be read in hundredths.

Fig. 11 shows the method of holding the specimen. A piece of steel rod a is placed in the loop of the belt, to take up the pressure from the two rods bb, whose section is a semi-circle; bb are fitted into grooves and are free to move, so that the pressure from them is always directed towards the center of a. A separate piece of belting c is placed between the jaw and the specimen to protect the latter from being cut by the jaws. Four bolts d are used to tighten the jaws. When the belt stretches its thickness is diminished. The bolts are then tightened more to prevent slipping. The jaws are connected to the piston of the ram by a ball and socket joint. They can thus adjust themselves to any unevenness in tension.

SPECIMEN NO. 1.

Width, 4 in. Sectional area, .84 square in.
Weight, .4768 lb. per lineal ft.
Cost, 42 cents per ft.
Broke at 4,170 lbs. per square in.
Total extension in 30 in. = 3.00 in. = 10 per cent.
Permanent extension, 0.13 per cent.

SPECIMEN NO. 2.

Width, 5 in. Sectional area, 1.1 square in.
Weight, .635 lb. per lineal ft.
Cost, 52 cents per ft.
Broke at 4,270 lbs. per square in.
Total extension, 14.9 per cent.
Permanent stretch, 3.0 per cent.

SPECIMEN NO. 3.

Width, 6 in. Section, 1.505 square in.
Weight, .844 lb. per lineal ft.
Cost, 62 cents per ft.
Broke at 3,790 lbs. per square in.
Total stretch, 16.4 per cent.
Permanent stretch, 3.0 per cent.

SPECIMEN NO. 4.

Width, 8 in. Section, 1.92 square in.

Weight, 1.032 lbs. per ft.
Cost, 84 cents per ft.
Broke at 3,700 lbs. per square in.
Total stretch, 17.0 per cent.
Permanent stretch, 1.9 per cent.

SPECIMEN NO. 5.

Width, 10 in.
Weight, 1.1434 lbs. per lineal ft.
Cost, $1.07 per ft.
Maximum load, 3,320 lbs. per square in.
Total stretch, 13.9 per cent.
Permanent stretch, 1.6 per cent.

SPECIMEN NO. 6.

Width, 12 in.
Weight, 1.2806 lbs. per lineal ft.
Cost, $1.30 per ft.
Maximum load, 3,540 lbs. per square in.
Total extension, 14.5 per cent.
Permanent extension, 2.4 per cent.

SPECIMEN NO. 7.

Width, 14 in.
Weight, 1.812 lbs. per ft.
Cost, $1.54 per ft.
Maximum load, 3,620 lbs. per square in.
Total extension, 15.8 per cent.
Permanent extension, 2.0 per cent.

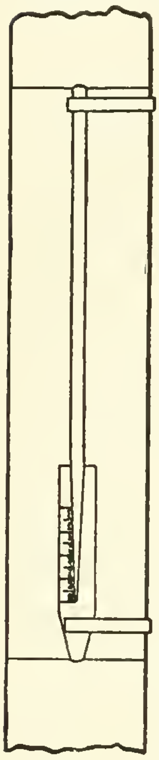


FIG. 10.

CAMEL BELTING.

This belting is made partly of cotton and partly of coarse camel hair, said to be the combings of camels. The cotton is the material which forms the chief strength, and therefore the longitudinal fibres are cotton. The hair yarn forms a woof, although in some of the specimens tested there were strands of hair running longitudinally as well as transversely. The two materials being interwoven in several plies, the belt is soaked in red paint and allowed to dry. The paint forms a good body coating, which protects the belt from moisture and makes it very durable. To prevent the belt from becoming stiff and hard an occasional coating of castor oil and tallow should be applied; but any resinous mixture is injurious. In making the lace holes a sharp awl should be used instead of a punch, as the latter cuts the threads and thus weakens the belt.

SPECIMEN NO. 1.

Sectional area, 4.35″ × 29″ = 1.262 square in.
Weight, .5717 lbs. per ft.
Cost, 33 cents per ft.
Total extension, 31.9 per cent.
Permanent extension, 11.6 per cent.
Maximum load, 5,960 lbs. per square inch.

SPECIMEN NO. 2.

Section, 5.07″ × .24″ = 1.22 square in.
Weight, .599 lb. per ft.
Cost, 39 cents per ft.
Total stretch, 35.1 per cent.
Permanent stretch, 4.45 per cent.
Maximum load, 5,570 lbs. per square in.

SPECIMEN NO. 3.

Section 6.1″ × .28″ = 1.71 square in.
Double or "Russian Brand."
Weight, .7995 lb. per ft.
Cost, $1.00 per ft.
Total extension, 24.5 per cent.
Permanent extension, 7.1 per cent.
Maximum load, 5,900 lbs. per square in.

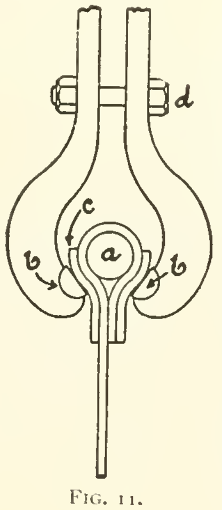


FIG. 11.

SPECIMEN NO. 4.

Section, 5.95″ × .22″ = 1.31 square in.
Weight, .599 lb. per ft.
Cost, 48 cents per ft.
Total stretch, 27.6 per cent.
Permanent stretch, 12.9 per cent.
Maximum load, 5,650 lbs. per square in.

SPECIMEN NO. 5.

Section, 6.1″ × 30″ = 1.83 square in.
Weight, .781 lb. per ft.
Cost, 58 cents per ft.
Total stretch, 20.6 per cent.
Maximum load, 5,360 lbs. per square in.

SPECIMEN NO. 6.

Section, 12.20″ × .31″ = 3.78 square in.
Weight, 1.705 lbs. per ft.
Cost, $1.33 per ft.
Total stretch, 38.0 per cent.
Permanent stretch, 19.3 per cent.
Maximum load, 5,160 lbs. per square in.

A glance at the curves shows that for small loads the extensions are uniform and even have a tendency to decrease until a certain limit is reached. The elastic limit comes much sooner than in rubber and leather, and there is an enormous extension at the ultimate strength.

The ultimate strength is much greater than that of rubber and leather, etc., but the belt would never be used in such high tension.

PATENT "BALATA" BELTING.

This kind of belting already described seems to be very good. It is very strong, and the amount of stretch is small.

The gutta percha is said to bend over small pulleys with more ease than rubber, and it is also claimed it resists heat and moisture better. It has cheapness in its favor, and is likely to become a popular belt. Only one specimen was tested:

Section, 4.45″ × .22″ = .979 square in.
Weight, .433 lb. per ft.
Cost, 46 cents per ft.
Total stretch, 15.7 per cent.
Permanent stretch, 4.4 per cent.
Maximum load, 5,210 lbs. per square in.
Table showing comparative value of belts:

Kinds of Belts.	Ultimate strength.		Total Stretch.	Stretch at 400 Lbs. per Square Inch.	Permanent Set.
	Per Square In.	Per Lb. per Ft.			
Leather.	4,320	12,200	10.5 to 18.3%	1.0%	0.5%
Rubber	3,773	7,290	14.6%	2.2%	2.05%
"Camel"	5,860	12,050	29.6%	2.25	13.1%
"Balata"	5,210	11,750	15.7%	1.16%	4.4

The column "Strength per lb. per ft.," gives a fair idea of the proportionate driving power that can be got out of the same weight of different kinds of belt.

The last two columns show the comparative values with regard to stretch.

PRICES.

Leather	10 cents per ft. for 1″ belt, to $12.00 per ft. for 72″
Rubber	21 cents per ft. for 2″ belt, to $6.72 per ft. for 52″
"Camel"	12 cents per ft. for 2″ belt, to $1.33 per ft. for 12″
"Balata"	21 cents per ft. for 2″ belt, to $1.30 per ft. for 12″

The "Camel" belting is by far the strongest, but its stretch is greatest. Where it can be used, the leather is probably the most economical, although it is very expensive in large widths. It is the lightest, and less power is lost by stretch.

The gutta percha comes next for lightness and driving power, and would therefore seem to be the most serviceable belt of all. But it is hardly fair to come to such a conclusion when only one specimen was tested.

The Montreal Cotton Company, of Valleyfield, Que., in addition to the very large increase order placed in August, have given a further order to the Canadian General Electric Company for a 150 h.p. induction motor.

In France two methods of electric traction on canals have been tried. In the one, a special form of electric car is propelled along the towing-path, and is connected to the barge by a rope. In the other, a detachable screw propeller worked direct by an electric motor is used. The current in either case is supplied by an overhead conductor and trolley.

No boiler will give good results unless the circulation is free and rapid. To overcome the difficulty experienced with some kinds, where there is no circulation in some parts of them, ejectors have been used to take the water out of the dead spaces and discharge it into other parts where the water is always in motion so long as there is any fire in the furnace.

Loose crank pins, and how to make them tight, is an interesting theme, and frequently comes up for discussion among engineers. One of the best remedies that I have heard of is to bore holes partly in the pin and partly in the boss of the crank, the holes being parallel to the axis of the pin, then driving in iron bolts that are a perfect fit and rivetting them solidly in place.

IMPROVEMENTS IN THE ARC LAMP.

By Robert A. Ross, E. E.

THE prominent place which the arc lamp took in the earlier years of electric lighting, involving as it did the designing and operation of the complicated series arc machine, has always excited comment, and the permanency of the types of apparatus then designed is astonishing. From the commercial beginning of arc lighting in the year 1879 up till the present, the direct current series lamp has undergone comparatively little change except in the smaller details. It is true that during the earlier years the questions of open and closed circuit types, of clock-work, clutch and rack feeds were fiercely discussed, but the lamps which have stood the test of time and which are now considered good commercial articles are much as they were when originally designed.

During the first eleven years of its existence the series arc lamp stood alone, in spite of the fact that the need was apparent for other types which would operate on the constant potential lines of direct and alternating systems. The result of the attempts to develop these types has been to produce in 1890 the constant potential direct current arc lamp to operate two in series on the 110 volt incandescent service lines, to give us, about 1892, the alternating current constant potential type, and in 1894 the enclosed type of the direct current arc.

At the present time all of these types are in successful operation, and in addition during the past year the enclosed alternating lamp has attained a thoroughly commercial form. The development of the several arc lighting systems by series, parallel, direct, and alternating current distribution has depended upon the development of suitable lamps alone, and gave us the series direct current system first, because of the simplicity of operation of the series lamp. The reason of this simplicity of operation is not far to seek, if we remember that after the arc is struck the regulating mechanism performs but one function, namely, to regulate the arc voltage, the current regulation being done at the machine regulator. On the other hand, the lamp mechanism for operation between constant potential lines regulates the arc voltage as well as the current, and as a consequence there is going on at all times a struggle between the forces by which these two factors are governed. It is this chiefly which necessitates the placing of a resistance in series with these lamps to prevent pumping. This trouble is not so apparent in the alternating type with which a choke or economy coil is used, as in addition to the resistance of the coil the inductance is of effect to dam back excessive current rushes. Another feature which long held the lamp for parallel operation in the background was the fact that the art of carbon-making had not advanced sufficiently to admit of the commercial manufacture of the high grades necessary for its successful operation. On the other hand, the force which has been of greatest effect in developing the constant potential type was the necessity which existed for the use of arc lamps on the incandescent service lines and the consequent uniformity and simplicity of the line and station equipment. The advantages attendant upon the use of the constant potential lamp have at the present practically banished the series arc from the field of interior lighting, and in many new plants are leaving no place for it even in what has been considered its own peculiar field, that of street lighting.

The question whether the series arc will retain its supremacy for outside illumination will depend largely upon whether machines capable of being direct connected or at least belted direct to fair sized engines can be built and operated. There seems to be a fair prospect of this, if we are to judge by the results of the past four or five years, within which time the limit of size has passed from about sixty to three times that number of lamps per machine. It is evident, however, that the limitations of safety will prevent the grouping of any such large number as might be desirable for other reasons on a simple series loop, and will force the adoption of systems of return loops as in the Brush machine, where several circuits are run from the same machine, and the line to line potential on each circuit correspondingly reduced, or by some other series parallel grouping of circuits which will give the effect of keeping down excessive line voltages while admitting of the use of large units in the station.

The advantages which the series system possesses for the distribution and control of light over large areas when coupled with the equally evident advantage of the use of alternating current generators, which are the standard type for most stations, have long been recognized, and some fairly successful attempts have been made to use alternating current lamps on series alternating circuits taken either from the constant potential bus bars of the station which feed the incandescent service primaries, or from the same bus bars through a self regulating transformer, which gives a constant current through the lamps placed in series on the circuit. As to the operation of these circuits there appears to be no great difficulty, and were it not for the fact that the light distribution from the alternating lamp is poor, and the cost of the superior carbons, which are necessarily so high, there is no apparent reason why this system should not displace the direct current series system with its separate and special generating units, thus permitting the distribution of incandescent and arc lighting from the same generators and the separate control of the arc lights as on the direct current series system at present in use. There appears to be a large field for this system in spite of the disadvantages mentioned above.

The development of the enclosed arc lamp has been a curious example of the effect of preconceived ideas in holding back much needed inventions. As early as 1846, Staite, recognizing the need for the enclosed arc with its long burning advantages, undertook its development, but without success, as were the efforts of others up till about 1894, when the lamp became a commercial success. The chief reason for the failures up to that time was that the endeavor had been to produce an arc similar to that in the open series lamp, which in the light of later knowledge was a mistake.

The open lamp has a normal arc of 45 volts, while the enclosed works to best advantage at about 80, the arc at the higher potential being much more stable and giving a better distribution of the light than at the lower voltage at which most of the experiments up till 1894 had been made. In addition to this misconception of the value of the long arc which enclosure made possible, the difficulty of obtaining enclosing globes which would withstand the heat, and the commercial impossibility of obtaining pure carbons which would not darken the globe, delayed seriously the appearance of the enclosed arc. These difficulties overcome, the increased voltage of the arc which in the series system is a disadvantage, were seen to be of decided advantage, as it enabled the lamp to be operated and controlled singly from the constant potential 110 volt lines from which the incandescent lighting was wired instead of two in series across the lines as the practice was with the open arc.

In comparing the relative advantages of open and enclosed arc lamps we find as follows:

1. That the enclosed type will burn for from 100 to 150 hours with one recarboning, as compared with 8 hours for single open lamps; the cost of the carboning and trimming being reduced in proportion.
2. For operation on constant potential circuits the ability to operate one enclosed as compared with two open lamps across the mains is a very evident advantage.
3. No dust, sparks or hissing from the enclosed lamp.
4. Simpler mechanism, and better regulation due to the longer arc, and less flickering in the enclosed type, as it feeds but one-fifteenth to one-twentieth as often as the open arc.
5. As compared with the series circuit open arc, the enclosed constant potential lamp operates on a low and very safe voltage, and may be handled and operated precisely as an incandescent lamp, thus making it especially suitable for interior illumination.

These are all advantages on the side of the enclosed type, but against this we must balance the decreased light giving power per watt of consumption due to the use of the opaline or ground enclosing globes which are necessary for the proper diffusion of the light, and the loss of light due to the smutting of the globes with carbon dust, which becomes a serious matter after about 100 hours of running; also there is the extra cleaning of the enclosing globe and the maintenance of same.

For interior illumination, however, where a ground globe is a necessity for proper diffusion in both cases, the open and closed types are on an equality so far as light giving efficiency is concerned.

It appears, therefore, that for all purposes of interior illumination and in many cases of outside lighting, the enclosed arc has decidedly the advantage, and the records in the larger cities of the United States show that these advantages have been recognized, and for most of the new installations of arc lamps the enclosed has been selected as the most suitable.

For the purpose of showing the different light giving efficiencies of the various types of lamps, as well as to place in accessible form the usual voltages and amperes in use in their respective arcs, the following table has been figured on the basis of 450 watts consumption at the arc in each case, that being the standard usually adopted. To complete the combinations all of the probable systems are considered, although several are not much used as yet, but the figures indicate what may be expected when they are adopted as the lamps are developed for all of them.

LIGHT GIVING EFFICIENCIES OF DIFFERENT ARC LIGHT SYSTEMS.

	Amperes	Volts in		Watts in		Candle power.		Watts per C P.		C.P. per H.P.	
		Arc.	Line.	Arc.	Line.	Outside.	Inside.	Outside.	Inside.	Outside.	Inside.
	1	2	3	4	5	6	7	8	9	10	11
DIRECT CURRENT.											
Series Open	10	45	50	450	500	650	450	.7	1.0	750	520
Series Enclosed	6.5	70	75	450	500	375	450	1.2	1.0	440	520
Constant Potential Open	10	45	55	450	550	650	450	.7	1.0	750	520
Constant Potential Enclosed	5.6	80	104	450	580	375	450	1.2	1.0	440	520
ALTERNATING CURRENT.											
Series Open	15	30	33	450	500	375	300	1.2	1.5	470	370
Series Enclosed	6.5	70	75	450	500	225	300	2.0	1.5	285	370
Constant Potential Open	15	30	33	450	500	375	300	1.2	1.5	470	370
Constant Potential Enclosed	6.5	70	75	450	500	225	300	2.0	1.5	285	370

Columns 1 and 2 give the volts and amperes at the arc; column 3 the voltage in the line or at the terminals of the transforming device, which is necessary for their commercial operation. Column 5 gives the consumption in watts at the terminals of the lamp. Column 6 gives the mean illumination of horizontal surfaces or the useful illumination from the lower hemisphere of the lamp, allowing for the absorption of light of 10% in the clear globe of the open lamp, and 40% in the opaline globes which are necessary for the enclosed type. If opaline or ground globes be used for all types as should be done in the illumination of interiors, the useful candle power is given in column 7, in which due allowance has been made for the effect of the upper hemisphere of light, of which it has been considered that 50% of that passing above the horizontal lines is reflected from walls and ceilings and becomes useful. These figures have been obtained from a consideration of a number of tests which vary widely, and can be considered as being as nearly as possible an approximation to average conditions. Columns 8 and 9 give the average watts at the arc per useful candle power figured from columns 6, 7 and 4, and indicate the probable consumption of energy in the arc per useful candle power for inside, and for outside lighting with the several systems. Columns 10 and 11 are figured from columns 8 and 9 and indicate the useful candle powers which may be expected per belt horse power in the station, allowing for fair average commercial efficiencies of generators, lines, transformers, choke coils, etc. The figures in column 10 indicate that for out-door illumination, where clear globes are used on the open lamps, and opaline on the enclosed type, to give a proper distribution the useful light giving efficiency of the direct current enclosed type is 60 per cent., of the alternating current open type 70 per cent., and of the alternating current enclosed type 40 per cent., of the direct current series arc per unit of energy in the station at the dynamo pulley. Column 11 indicates that for interior illumination where opaline globes are used on all types to get proper dispersion, the direct current lamps on all systems are on a par, and the alternating lamp efficiency in all cases about 70 per cent. of the direct. In considering these results it must be remembered that the series machine is much less efficient than the constant potential machine, which makes up for the smaller efficiency of the lamps on that system, and that the alternating arcs have a large light giving area above the horizontal which is considered as partially useful in columns 7 and 11 for inside lighting, but is considered as wasted for out-door illumination in columns 6 and 10. The direct current type, owing to the shape of the positive carbon, throws its light mainly downwards, and the upper hemisphere of light plays little part in interior illumination.

From the above considerations it appears that for outside illumination the series open arc will hold its own where the question of the simplification of the plant by doing away with the arc machines is not given first place. For interior lighting on the other hand, the enclosed direct current, or the alternating lamp of either open or closed types, will certainly displace the series arc, and will broaden that field largely and displace many incandescent lamps in large interiors. For this purpose arc lamps of small candle powers which are now offering will find a place. It must be remembered, however, that the candle power per watt of consumption for these smaller lamps decreases quite rapidly as the current consumption is lowered.

SPECIMEN OF MUNICIPAL TACTICS.

To the Editor of the CANADIAN ELECTRICAL NEWS :

SIR,—Knowing that you are a great admirer of nerve, I send you the enclosed, received from the clerk of the Water and Light Department of a city in the maritime province where there is apparently a municipal plant. For a concentrated essence of the above commodity this breaks the record. It is not enough that the municipalities want to confiscate our business without compensation, but expect us to find them with brains enough to run the thing to boot.

If the town has not a man in its employ who knows enough to give this information, it ought to have, and should get one right away. If they cannot afford to pay for one (which seems likely), they have no right to be in the business at all. Such information can only be had by years of costly experience, and is worth money. If the municipality is determined to have such a luxury as a civic electric plant, they should be willing to pay the piper for the music they want to dance to.

Yours truly,

VINDEX.

[COPY.]

CITY OF MONCTON, N. B.,
Water and Light Department, OCTOBER 20, 1898.

TO THE MANAGER

DEAR SIR,—We have been considering the advisability of making some changes in our electric light plant, and wish to get the opinion of competent men on the following points :

Which do you consider, high or slow speed engines, the most economical for steam plant? What are you using in your station? Name maker and style of engine used.

What is your average consumption of coal per horse power hour? What is your consumption of oil in proportion to horse power?

What do you consider the best and most modern arc dynamo on the market? Also the best incandescent alternating dynamo?

What do you figure the net cost per incandescent lamp per night (all night)? Also to 12 o'clock?

What type transformer do you consider the best?

What type of transformer do you use?

What does your coal cost? What kind do you use?

What does your oil cost per gallon—cylinder, engine and dynamo?

What do you charge per incandescent light per night?

What are your meter rates per 1,000 watts?

What do you charge per commercial arc light per night?

What do you charge per street arc light per night?

We are at present supplying about 1,000 incandescent lights, 53 street arc lights, and 40 commercial arc lights.

Average run summer months 10 hours, winter 16 hours.

Our incandescent circuit is about 10 miles, our arc circuit about 14 miles.

We would like your opinion as to the number of men required, including electrician, to operate a plant of this capacity. The latter question would not include our engineer and manager, or accountant.

You will understand that we have the water and gas as well under our management.

The above staff to make all extensions to circuits, all repairs, installations, etc.

We would thank you if you can answer the above at an early date : trusting it may come in our way some day to return the compliment.

Yours sincerely,

CITY OF MONCTON,
Per M. L.

ENGINEERING NOTES.

INSPECTING BELT LACING.—A good practice is to draw in extra pieces of lacing over the regular strips, and then have a board in close proximity to the belt as it runs. The result is that the outside pieces, which are not intended to hold any of the stress, catch all of the wear, and as soon as a piece is worn in two the centrifugal force due to its motion causes it to strike the board and attract attention. It is not at all necessary to shut down when this warning note is heard, for no one will know it to be but the outer part, but it should be attended to the next time that the engine is shut down. The adoption of this plan will save delays in many places where they are now considered a necessary evil.

OLIVE OIL.—There is no question but olive is the best oil to be used for many purposes in both mill and shop ; its advantages over other kinds are that it softens, and even after a year or more does not become stiff and hard, and the oil remains fresh and sweet in it. It is very difficult to detect adulteration in oil, and as olive oil is mixed to a large extent with cotton seed oil, it behooves the purchaser to be very careful what he is doing, or some smart "drummer" will sell him a few barrels of cottonseed oil with a little olive mixed in for the best pure olive oil. The following is a good test for oil : Take a portion of the oil and stir it up with forty parts of a solution of carbonate of soda of three degrees of Baume. If the oil forms a milky emulsion, without any oil drops on the surface, it is a guarantee for a good greasing of the object to which it is applied.

BOILER CLEANERS.—A correspondent of the Scientific Machinist, on the advice of a brother engineer, took a good sized stick of cordwood (oak), put it in the boiler and screwed it to the brace so that it could not get fast between the flue and the shell when the water was low. After a week's run he found a great deal of scale had come off the sides, and a lot more was loose that was easily knocked off. At the end of the third week the scale was loose on the flues and easily knocked off. By continuing to use oak wood and to clean out once a week, in a remarkably short time he had the boiler free from scale. The difference in firing alone was no small matter. It is best, he says, to clean every week when using the wood, as it does not reduce the scale to a mud. Blowing off causes it to gather around the blow-off, which, if left too long, is apt to burn the shell, owing to its keeping the water from the shell.

BUSINESS IS BUSINESS.

"The man who whispers down a well
About the goods he has to sell,
Won't reap the gleaming golden dollars
Like one who climbs a tree and hollers."

W. Miller, of Glen Miller, Ont., is installing a new electric plant for his paper mills, and has purchased a 150 light machine from the Canadian General Electric Company.

The Robb Engineering Co., of Amherst, N.S., have established an agency at Winnipeg, Man. Their representative, Mr. John Carroll, recently made a trip through British Columbia and the west.

SPARKS.

Madill Bros., of Lakefield, are offering their electric plant for sale.

The city of Victoria, B.C., will likely appoint an inspector of electric wiring.

During the coming winter the Ottawa Electric Railway Company will build a large number of open street cars.

The directors of the St. Thomas Street Railway Company are considering the extension of their road to Port Stanley.

The town of Owen Sound, Out., invites tenders up to 15th inst. for the construction of a fire alarm telegraph system.

Negotiations are under way for the construction of a telephone line from Hickson to Tavistock, Ont., a distance of six miles.

Messrs. Munderloh & Co., of Montreal, recently ordered from the Canadian General Electric Company a 6 kilowatt incandescent dynamo.

Messrs. Barber Bros., of Georgetown, recently ordered from the Canadian General Electric Company a six kilowatt 500 volt motor.

Some of the citizens of Ste. Genevieve and Point Claire, Que., are considering the advisability of constructing an electric railway connecting the two places.

Mr. Roderick J. Parke, E.E., of Toronto, is preparing an estimate of the cost of installing a municipal electric light plant for the town of Pembroke, Ont.

A by-law to provide the sum of $6,000 by the issue of debentures for the purchase of an electric light plant has been sanctioned by the ratepayers of Acton, Ont.

Messrs. Geo. White & Sons Co., Limited, of London, Ont., are at present engaged in erecting a new boiler shop, 70 x 70 feet, to meet the increased demands of their business.

The corporation of the city of New Westminster have ordered from the Canadian General Electric Company a 100 light incandescent dynamo and a six h.p. 500 volt motor.

The London Electric Company have just placed an order with the Canadian General Electric Company for two of their standard No. 12 125 light multi-circuit Brush arc dynamos.

James Richardson & Son have ordered from the Electrical Construction Company of London, Limited, a forty horse power multipolar motor, to operate G. T. R. elevator No. 2.

Mr. J. H. Head, of Hagarsville, Ont , has recently ordered from the Canadian General Electric Company a very compact lighting plant. The generator will have a capacity of 50 lights.

The Bells Asbestos Company, of Thedford Mines, P. Q., have ordered from the Canadian General Electric Company a 100 light dynamo, to be installed at their premises, Thedford Mines.

The British Columbia Sugar Refinery Company, of Vancouver, have recently ordered from the Canadian General Electric Company a 25 kilowatt generator of the well-known multipolar type.

The Peterboro and Ashburnham street railway was sold recently to Mr. Arthur Stevenson, for $20,000. It is understood that Mr. Stevenson acted for some of the stockholders of the existing company.

The provincial asylum at Fairville, N.B., have placed an order with the Canadian General Electric Company for a six kilowatt motor and one 8½ kilowatt motor, of the well-known Edison bipolar type.

Messrs. Krug Brothers, of Chesley, Ont., have recently given an order to the Electrical Construction Co. of London, Limited, for a lighting plant, including a 150 light multipolar dynamo for incandescent lighting.

Mr. W. J. Camp, electrician for the C. P. R., is at present in Winnipeg, supervising the installation of the plant in the new offices of the company in that city. This plant, when completed, will be modern in every respect.

Mr. John Galt, C.E. and M.E., of Toronto, is designing an electric light plant for the town of Prescott, Ont. Commissioners will be appointed at the forthcoming January elections to arrange for the installation of the plant.

The Dundas Electric Company, Limited, of Dundas, Ont., have obtained a provincial charter, to supply light and power. The capital is $40,000, and among the promoters are Messrs. John Bertram, G. H. Harper and E. B. Harper, all of Dundas.

The Fire, Water and Light Committee of the city council of Winnipeg, Man., are considering the question of submitting a by-law to the ratepayers to provide funds for the purchase of an electric light plant for lighting the streets and municipal buildings.

The directors of the Victoria Industrial School, Mimico, Ont., have decided to install an electric plant for the lighting of the various buildings, and to carry out this work have purchased a 300 light plant from the Canadian General Electric Company.

The Iron Mask Gold Mining Co., of Rossland, B. C., have decided to operate their hoisting, drilling and carrying apparatus by electricity, and for this purpose have placed with the Royal Electric Company at Montreal, an order for 100 k.w. S.K.C. synchronous motor.

The Linde British Refrigeration Company, of Montreal, have recently ordered from the Canadian General Electric Company a 15 h.p. three phase induction motor. The power will be supplied to this induction motor from the circuits of the Lachine Rapids Hydraulic and Land Company.

Montreal shippers have complained to the Department of Agriculture at Ottawa respecting damage occasioned to perishable articles of export, owing to lack of proper ventilation on some of the steamships. It is understood that about fifteen of the ocean-going steamers sailing from Montreal will be fitted this fall with electric apparatus for ventilation.

The employees of electrical companies in Toronto have organized a union, under the name of the Brotherhood of Electric Workers of Canada, in affiliation with the Trades and Labor Council. Mr. Thomas Eaton is president and Mr. F. Marson secretary.

Messrs. Wm. Jensen and Lawrence Goodacre, of Victoria, B.C., are endeavoring to form the Hardy Bay Tramway Company, Limited, to build a tramway from Hardy Bay to Coal Bay, Quatsino Sound. Should the scheme be carried out it is probable that electricity will be the motive power.

The City Council of St. Thomas, Ont., has instructed Mr. James A. Bell, city engineer, to make an estimate of the cost of a civic lighting plant of 100 arc lights for street purposes, and 3,000 incandescent lights for commercial purposes, the plant to be erected separate from the water works.

The War Eagle Consolidated Gold Mining Company, of Rossland, B.C., have ordered from the Canadian General Electric Company two 2 h.p. induction motors and one 10 h.p. induction motor. The power to operate these induction motors is to be furnished by the West Kootenay Power & Light Company.

The Stouffville Electric Light Co., of Stouffville, Ont., are making changes in their electric lighting station, among them being a new dynamo, with a capacity of about 500 lights. They are putting in an S.K.C. two phase machine from the works of the Royal Electric Company, so that they can supply power as well as light.

The People's Electric Company, of Windsor, Ont., owing to the very large and satisfactory increase in their lighting business, have recently placed an order with the Canadian General Electric Company to supply them with one of their 2,000 light iron-clad ventilated armature type single phase alternators.

The town of Campbellton, N.B., are installing a civic electric lighting plant. They are putting in Robb-Armstrong high-speed engines, with Monarch boilers, and one 60 kilowatt S.K.C. two phase dynamo, with the full capacity of the machine in transformers. They intend to use this S.K.C. machine for the supplying of arc lamps for the streets and incandescent lights for interior lighting, as well as for power in the daytime.

Mr. H. D. Symmes, of St. Catharines, has secured the contract from the corporation of Merritton for the lighting of their streets with 20 arc lamps. Mr. Symmes has also decided to undertake the operation of a commercial lighting plant, and for his requirements for this purpose has purchased from the Canadian General Electric Company one of their 1000 light, standard single-phase alternators. He proposes operating a street lighting service from the alternating system, using 2,000 c.p. enclosed alternating arc lamps. These lamps he has also purchased from the Canadian General Electric Company.

The British Columbia Gazette announces the incorporation of the Rossland Air Supply Company, with a capital of $200,000, the object being to develop water powers under what is known as the Taylor hydraulic system of air compression. The company will first develop its power on Beaver Creek, it being proposed to transmit 2,000 horse power to the Le Roi mine, a distance of ten miles. The initial pressure will be 135 pounds, and the air will be transmitted through a 14" wrought iron pipe. The cost of the plant is estimated at $150,000. Mr. A. J. McMillan, of Rossland, and Mr. D. J. Fitzgerald, of Trail, B.C., are interested.

An important change has been made in the course of lectures on "Steam and the Steam Engine" at the Toronto Technical School. This consists of dividing the subject into two parts, so that as well as the lectures on "the theory of heat engines or thermodynamics" others will be given of a practical nature, dealing with "the indicator, valves and valve motions, efficiency of engines and boilers, gas engines, etc." Mr. Harris P. Elliott, B.A.S.C., who has charge of this course, has had considerable experience in the actual design and construction of engines, and it is hoped that in this way it can be made interesting to mechanics and others who are not qualified to take the theoretical work.

Steam users throughout Canada and the United States now recognize the fact that the steam boiler is the source of energy of their factory, and its proper care is their aim. Not only do they give attention to external fixtures, but thoroughly investigate the interior, as experience has shown that corrosion, pitting and scaling cause expensive repairs, large fuel bills, and sometimes loss of life and property. It is not surprising, therefore, that the Wm. Sutton Compound Co., of Toronto, report many enquiries for their boiler compound. They state that they have been compelled to increase their staff and plant on different occasions, and that the compound is meeting with success from the Atlantic to the Pacific. It is a reliable preventive for scale and corrosion, and is claimed to be the only pure vegetable compound free from acid, caustic soda or zinc.

The Lunenburg Gas Co., of Lunenburg, N. S., are changing their electrical plant from steam to water power. They have a sixteen foot dam nearly completed on the Mush-Mush river at Mahone, eight miles from Lunenburg. This river, though small, has over ten square miles. These the company control, and can thus regulate the flow of the river as their needs may require. The Canadian General Electric Company are supplying the wire, transformers, switchboard and a 100 k.w. three phase generator. The pole line is completed, and is said to be the finest in that part of Nova Scotia. The water wheel is from the works of the S. Morgan Smith Co., York, Pa., and is one of their well-known "New Success" turbines. The company will light the village of Mahone, in addition to supplying light and power in Lunenburg

SPARKS.

An electric light plant has been installed in Fould & Shaw's flour mill at Thorold, Ont.

Some of the ratepayers of Bradford, Ont., are in favor of taking steps to secure electric lighting.

The Hamilton Radial Railway Company have let contracts for the extension of their road to Port Nelson.

The directors of the Hull Electric Railway Co. are considering the extension of their road to Gatineau Point.

The town of Bothwell, Ont., will vote on a by-law to raise the sum of $4,000 to install an electric light plant.

The Cornwall Electric Street Railway Company are said to contemplate considerable improvements to their system.

The Citizens Electric Light Co., of Smith's Falls, Ont., have added to their equipment a new dynamo of 1500 lights capacity.

The Goldie & McCulloch Co., of Galt, Ont., are supplying three large boilers for the C.P.R. elevator at St. John, N.B.

The Bell Telephone Company are fitting up a new exchange at Perth, Ont., under the direction of the district superintendent, Mr. Gilmour.

A proposal to expend the sum of $5,000 in improving the electric light plant was voted down by the ratepayers of Mitchell, Ont., on October 18th.

The town council of Thorold, Ont., has postponed until January next the submission of a by-law to provide $7,000 for the extension of the electric light plant.

O'Rilley & Murphy, of Ottawa, have put in the necessary fittings and wiring for lighting the Rideau street convent in that city. In all, about 150 incandescent lights are wired up.

The Bell Telephone Company have been given a renewal of their telephone franchise in the city of St. Thomas, Ont., having reduced the price of telephones in residences to $20 per year.

Jas. Parcell, second engineer of the steamer Chicora, plying between Toronto and Niagara, was presented with a handsome cruet stand by the mechanical and engineering staff on the last trip of the steamer for this season.

Mr. John Shields, well-known in Eastern Canada, has recently completed the installation of electric lighting and waterworks plants at Ashcroft, B.C. The plants are said to be among the most complete in the province.

The Dominion Public Works Department reports that excellent progress is being made in deep water telegraphs. A line has been laid along the north shore of the St. Lawrence, and the cable will soon be completed to Belle Isle.

The Lake Ontario Navigation Company are building a new steamer, to be equipped with an electric light plant, the contract for which has not yet been awarded. Mr. A. W. Hepburn, of Picton, Ont., is the principal member of the company.

The Montreal Street Railway Company discovered that car tickets were being stolen by certain conductors, and have taken steps to punish the offenders. The method of the conductors was to pull the tickets out of the box, either by means of the finger or a small wire.

The village of Grenville, Que., offers a good opening for the installation of an electric plant for lighting the village and both sides of the river, as well as the canals. There is an almost unlimited water power, and favorable terms could, it is thought, be made with the municipality.

A. G. Best, agent for the Massey-Harris Company at Cobden, Ont., was injured in an acetylene gas explosion recently. Mr. Best was installing a generator, when he held a lighted candle near the carbide chamber, thus causing the explosion. His injuries are not regarded as serious.

The town council of Orillia, Ont., at a recent meeting, discussed the question of engaging a consulting electrical engineer. The Fire and Light Committee recommended the engagement of Mr. Roderick J. Parke, of Toronto, which recommendation was finally concurred in by the council.

The telegraph operators employed on the Canada Atlantic Railway waited upon Mr. J. R. Booth and presented a demand for shorter hours and higher wages. The men work 12 hours a day, and receive an average salary of about $35 per month. As yet their demands have not been complied with.

The Canadian General Electric Company have just received an order from William Cook, of St. Catharines, for one of their standard 60 kilowatt single phase alternators. It is Mr. Cook's intention to undertake the furnishing of light to private consumers in connection with his present power plant.

A special committee was recently appointed by the city council of Halifax, N.S., to report as to the advisability of the city undertaking its own street lighting. As a result thereof, the city engineer and electrician have been instructed to prepare plans and specifications, and invite tenders for an electric light plant.

A proposal is under consideration to build an electric railway from Rondeau Park to Thamesville, via Ridgetown, Selton and Morpeth. At a recent meeting held at Ridgetown, at which Mr. Robert Ferguson, M.P.P., was president, and Mr. W. E. Gundy secretary, it was decided to form a directorate and apply for a charter.

The Dominion government is asking for tenders up to November 21st for the erection of a power house and the installation therein of the necessary electrical apparatus for operating the locks, bridges, etc., and for lighting the Soulanges Canal. Plans may be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa.

Justice Walkem has given judgment for the plaintiff in the case of Arthur vs. the city of Nelson, a motion to quash the electric light by-law authorizing the council of Nelson, B.C., to borrow money to purchase an electric light plant from a private company. Mayor Houston was a director of the company, and on that ground the by-law was quashed.

The Metis Telephone Company, at a meeting held at St. Octave de Metis, Que., elected the following officers: Honorary president, Dr. J. A. Ross, M.P.; honorary vice-president, Mr. L. F. Pinault, M.P.: directors, Rev. Mr. Chouinard and Messrs. L. M. Desrosiers, Jule Gendron, A. C. Landry, L. M. Langlais, Dr. J. C. Demers and Donati Caron.

The St. Malo, Que., municipal council has granted the Jacques Cartie Water Power Co. exemption from taxation for 15 years, on condition tha they furnish electric light gratis to the municipality.

The Rogers Electric Co., of London, Ont., have removed their head office to Toronto, but will retain a branch in London. They purpose giving close attention to the electrical supply trade.

Arrangements are in progress for the construction of a local telephone line from Cannington to Hartley, Victoria road, Kirkfield and other points. The line will give a circuit of about 60 miles.

Early in October the annual meeting of the Exeter Electric Light Co. was held at Exeter, Ont., at which a dividend of 5 per cent. was declared. Since the meeting the plant has been sold to Messrs. Snell & Tremaine.

S. Paquette was instantly killed in Montreal by coming in contact with a live wire. He was swinging a derrick when it touched the wire, the insulation of which was worn off, and a current of 2000 volts came down the derrick wire rope and killed him.

Mr. J. A. Jamieson, superintendent C.P.R. elevators, St. John, N.B. has given an order to the Canadian General Electric Company for one 30 kilowatt generator of their well-known type, together with all the wiring material required to complete the installation.

Mr. Jas. Patterson, engineer for the Hamilton, Grimsby & Beamsville Electric Railway Company, estimates the cost of extending the road from Beamsville to St. Catharines at $107,000, there being a grade of 3 per cent. It is improbable that the extension will be carried out.

The annual meeting of the Merchants' Telephone Company was held in Montreal early in October. It was decided to increase the capital stock by $100,000. Officers were elected as follows: President, A. S. Hamelin; vice-president, J. E. Beaudoin; treasurer, L. E. Beauchamp; directors, A. S. Delisle, L. H. Henault, S. L'Archeveque, J. B. Thibodeau, J. N. Ducharme and R. Beauchamp.

A special meeting of the shareholders of the Royal Electric Co. took place in Montreal on October 18th, to consider the proposed issue of $500,000 of preferred stock and the proposal for the Royal Electric Co. to increase its holdings in the Chambly Mfg. Co. from $200,000 to $300,000. The shareholders voted against the issue of preferred stock, but the increased holding in the Chambly Mfg. Co. was carried unanimously.

The corporation of the town of Campbellford, Ont., has recently passed a by-law for the purpose of remodelling and increasing their electric plant, and to carry out the work have purchased from the Canadian General Electric Company one of their standard 120 kilowatt single phase alternators complete, together with the necessary transformers and wiring material. It is expected that, when completed, this will be one of the most modern plants in Canada.

A rumor was current in Toronto a fortnight ago that a scheme was under consideration for the consolidation of all the street railway systems in Canada. It is learned, however, that there were no grounds for the report, which evidently originated from the fact that a number of well-known capitalists interested in street railway ventures convened in Toronto on the 20th inst. It is now stated that a scheme for the extension of radial railways from Toronto throughout the province was under consideration.

A meeting of the shareholders of the Grand Falls Water Power and Boom Company was held at Fredericton, N.B., on October 21st. It was reported that the capital stock of the company, which is $1,000,000, had been subscribed. Plans of the proposed works have been approved of by the Governor General-in-council, and operations are to be commenced forthwith. Hon. R. A. Alger, Sir William Van Horne, R. B. Angus, Hon. Rodden Proctor, William Mackenzie and Hugh McLean were elected directors.

Messrs. Howes & Leighton, of Harriston, Ont., have decided to comply with the request of the merchants of that place to provide incandescent lighting for commercial and residential purposes, as well as arc lighting, which they are now furnishing, and for this purpose have placed an order with the Canadian General Electric Company for one of their new type 30 kilowatt single phase alternators, with marble panels, instruments and all the transformers and wiring required for the installation.

The Ontario government will likely ask the courts to determine whether or not the Niagara Power Company has forfeited the charter which it obtained from the provincial authorities. The agreement between the government and the company called for the development of 10,000 horse power by the 1st November last, and of 25,000 horse power by a later period. The government takes the view that the company has not fulfilled the first of these conditions, and that it has therefore no further right to the charter. The company, on the other hand, points out that under another section of the agreement the charter was only to be forfeited in the event of a failure to transmit electricity. It claims that it has been impossible to comply with the latter condition, as up to a very recent period the problem of long distance transmission had not been solved. Furthermore, the company says it cannot fulfill the contract to supply electrical energy because there is no demand for it.

BANQUET OF STATIONARY ENGINEERS.

THE Toronto branch of the Canadian Association of Stationary Engineers will hold their annual banquet on Thanksgiving eve, November 23rd. The event will take place at the Walker House, where the accommodation will be of the best, and an evening of profit and social re-union is assured. The dinner committee is as follows: John Marr, chairman; Chas. Moseley, Wm. Tait, Geo. Thomson, Geo. Mooring, John Bain, John Bannon.

ELECTRIC RAILWAY DEPARTMENT.

THE ST. THOMAS STREET RAILWAY.

The St. Thomas street railway, which for so many years gave to the city the name of the horse-car town, has passed away, and in its place a real live, up-to-date electric street railway service is in full blast. The work of constructing the new road was undertaken by local capitalists entirely, with one exception, and June 15th, 1898, saw the road complete and in full operation.

Mr. Chas. McBeth, a graduate of the School of Practical Science, was engaged as electrical engineer, and is said to have handled the work with the assurance of a veteran. Mr. McBeth superintended the electrical equipment, while Mr. Thos. Kerr, of the London Street Railway, gave him valuable assistance with the track laying. The work of laying the track was proceeded with rapidly, no trouble between the city and the railway company arising to hinder the work, as is too often the case.

The company, instead of building a power house for themselves, engaged room in the spacious power house of the Gas & Electric Light Company, and purchased two 150 h.p. generators from the Canadian General Electric Company, and two engines from the Robb Engineering Company, of Amherst, Nova Scotia, the manager of the Gas & Electric Light Company looking after the working of them, and the railway paying for the power generated. The road is equipped with eight motor cars and two trailers of the most improved type, supplied by the Ottawa Car Company, the trucks being obtained from the Canada Switch & Spring Company, of Montreal. The cars are equipped with Canadian General equipment, 25 h.p. motors and double controllers. The cars at present in use have been found insufficient, and next spring it is the intention of the directors to place several more on the road.

The length of track is seven miles, five miles of a belt and two branch lines, one to the stations of the L. E. & D. R. and Grand Trunk Railways, and the other to the company's park, which is one of the features of the road. The park comprises about 100 acres, and is partly wooded by a beautiful bush. It is situated on the banks of Lake Pinalore, a very picturesque spot. Baseball, golf, cricket, lawn tennis, and bowling clubs are accommodated there with suitable grounds, bathing, boating and fishing appliances being furnished for these pastimes. Buildings are being erected for the accommodation of pic-nic and dancing parties. The directors are sparing no pains to make this one of the most beautiful parks in western Ontario, the natural facilities of the location assisting them very materially. This park is a boon to the city, being just what has been required for a number of years, and the electric railway has made it easy of access.

Mr. J. H. Still is president, and Col. Stacey, who held the horse car franchise, secretary-treasurer of the company. Mr. A. Bingham, who for fourteen years was local manager for the Bell Telephone Company in some of their largest exchanges, gave up that position and assumed the management of the street railway, preferring a larger field than the telephone offered for his labors. The road has every prospect of being a success financially, and should the company decide to go to Port Stanley with an extension of their line, which is a possibility, there is no question but that the road will prove a bonanza to the shareholders.

LONDON STREET RAILWAY STRIKE.

As we go to press, a strike of the employees of the London, Ont., Street Railway Company is assuming a serious aspect, and much speculation is rife as to the outcome of same. On October 24th the men formed a division of the Street Railway Employees' Union, and submitted to the management of the road a petition asking for an increase in wages and a more regular division of work. They also asked that only union men be employed. A committee waited upon Mr. C. E. A. Carr, the manager, but he refused to recognize the union. It was then decided to inaugurate a strike, which was done, and since that time several unsuccessful attempts have been made by parties concerned to effect a settlement.

The company has offered to increase the scale of wages, but the men insist that the union shall be recognized. The strikers have, in some instances, resorted to despicable tactics in their efforts to accomplish their purposes, and for the past week no attempt has been made to run the cars. The company has refused a proposal made by the men to refer the matter to the arbitration of the Mayor, Judge William Elliott and Crown Attorney Magee, and thus negotiations with the men would seem to be at an end. The conditions under which the street railway franchise in London was granted provide that the company must employ residents of the city exclusively. This provision, to which the company should never have agreed, has greatly assisted the strikers, as in bringing in outside workmen the company are in danger of losing their franchise.

SPARKS.

The Yarmouth electric railway will probably be extended to Port Maitland next spring, says the Yarmouth News.

It is believed that the Ottawa Electric Company still have in view the extension of their line to Britannia. No steps will be taken, however, before next spring.

Mr. J. W. Leonard, general superintendent of the Ontario and Quebec division of the Canadian Pacific Railway, has been appointed a director of the Galt, Preston and Hespeler Street Railway Company.

The strained relations between the Weston village council and the Toronto City & Suburban Railway are at an end, an agreement satisfactory to both parties having been reached. By the agreement the railway company get back their franchise, and in return will extend their line 1,200 feet from its present terminus.

On October 31st the Ottawa Electric Railway Company made a test of a new fender on one of their cars. It is manufactured by the Consolidated Car Fender Co., of Providence, R.I., and is composed of two distinct parts, a cradle and a cushion. A steel bar projecting to the rear, under the platform, holds the cradle at any desired height. By means of a latch or trigger to be pressed by the foot of the motorman, the cradle is released so that its front edge drops to the ground, making it impossible for anything to get under the car. The cushion is a Resiliant shield made of carefully tempered steel bands. This covers the iron bumpers and all other projecting parts of the platform, so as to effectually cushion the plough in case of a person being struck by a fast moving car. The Ottawa Car Company have taken the agency for Canada, and will manufacture the fender in Ottawa. The railway company will, it is said, apply this fender to 50 cars at once.

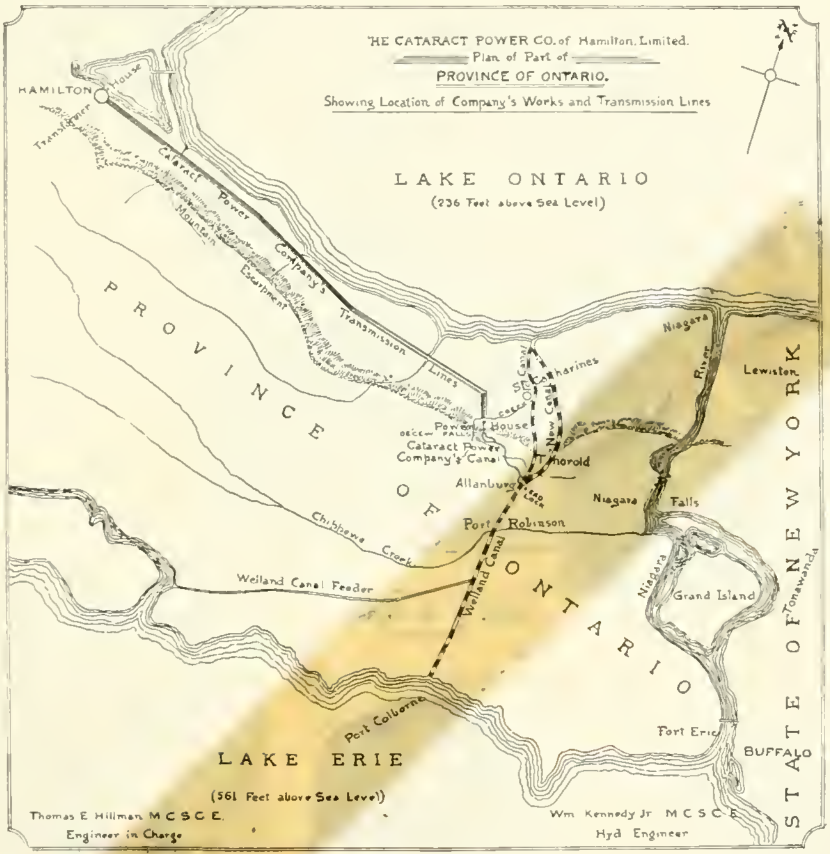
CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. VIII. DECEMBER, 1898 No. 12.

THE CATARACT POWER COMPANY OF HAMILTON.

Description of an Important Canadian Electrical Enterprise.—Demonstration of the Practicability of Long Distance Power Transmission.

SATURDAY, November 12th, will go down, in the electrical annals of Canada, a red letter day, as it will chronicle the formal opening of the electric power plant of the Cataract Power Company of Hamilton, Limited, for the transmission of electrical energy from a point on the Niagara escarpment, near DeCew Falls, to Hamilton, a distance of 35 miles, the conception and carrying out of which must always stand as a monument of business pluck and enterprise on the part of those interested in and forming the Cataract Power Company.



Over three years ago, when the transmission of energy by electricity over long distances for commercial purposes was still in much of an experimental stage, the possibility of utilizing the magnificent fall of over 200 feet, obtainable at DeCew Falls, where the waters of the Beaver Dam creek tumble over the Niagara escarpment, for the generation of electrical energy to be transmitted to the city of Hamilton, 35 miles distant, suggested itself to Mr. John Patterson, of that city. After numerous surveys and examining into the physical feasibility of the scheme, he associated with himself the Hon. J. M. Gibson, John Moodie, sr., James Dixon and J. W. Sutherland, all well-known citizens of Hamilton. Together they procured a charter and formed the Cataract Power Company of Hamilton, Limited, for the purpose of the development of this power and the transmission of it to Hamilton.

After the formation of the company the ground was again gone over carefully, and it was found advisable to abandon the original idea of utilizing the waters and water-ways of the Beaver Dams creek and the DeCew Falls, and by changing the plans some very material advantages were gained :

First, the securing of a supply of water which would be constant, through a feeder from the Lake Erie level of the Welland Canal at Allenburg.

Second, the construction of a canal, 4¾ miles long, over private right of way, thus giving the company an unobstructed water-way.

Third, the securing of land along the private water-way for storage basins, by which the company can conserve its water at a period of non use or light load for use at the time of heavy load.

Fourth, by going three-quarters of a mile east of DeCew Falls along the Niagara escarpment, an additional fall of 70 feet was obtained, which was a very valuable acquisition. At this point there were also exceptional natural advantages, both at the top of the escarpment for the anchorage of flumes, erection of penstocks, etc., and at the foot of it for the discharge of the tail water, as well as a splendid site for the power house.

The hydraulic development, as it was desired by the Cataract Power Company, presented obstacles which, owing to the large units and to the high head, made it exceptionally difficult to secure a builder of water-wheels who would give what the hydraulic engineer's specifications called for. After a long delay and much negotiation the Stilwell-Bierce and Smith-Vaile Company, of Dayton, Ohio, agreed to build special horizontal turbines of about 2000 horse power each, to work under a head of 265 feet, and to operate at a speed of 400 revolutions per minute. This required, also, special valve and valve gear and controlling devices, all of which were specially designed for this particular plant.

The generation of the electric power and the transmission of the same from the power house to the City of

Mr. James Dixon,
Vice-President.

Mr. John Patterson,
Secretary and Original Promoter.

Mr. John Moodie,
Treasurer.

Hon. J. M. Gibson,
President.

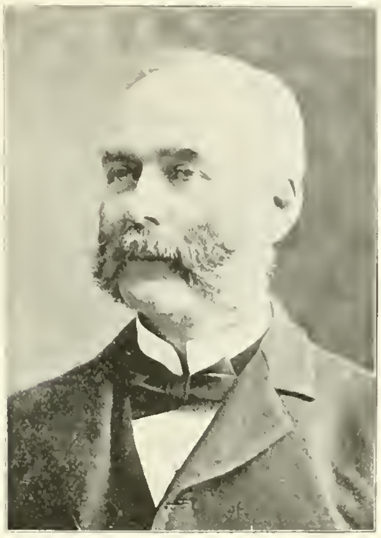
Mr. J. A. Kammerer,
Electrical Adviser.

Mr. John Dickenson, M.P.P.

Mr. J. W. Sutherland.

DIRECTORS OF THE CATARACT POWER COMPANY OF HAMILTON, LIMITED.

Hamilton, a distance of 35 miles, presented at that time a seemingly insurmountable obstacle to the carrying out of the scheme, no transmission of energy such a long distance, for commercial purposes, having up to that time been undertaken. The largest electrical concerns, both in Europe and America, were consulted, but the limitation of a practical working pressure, sufficiently great to insure the transmission of power such a long distance, practically precluded the undertaking of the work by any of the companies consulted, the highest working pressure, up to that time, being not above 10,000 volts. At this pressure the cost of the transmission line became so great that the Cataract Power Company did not feel warranted to undertake the development of the enterprise. The longer the distance, the heavier the conductor must be ; therefore to transmit over this long distance, it was necessary that the pressure be 20,000 volts or over, so that the cost of the conductor would be within the limit set, to allow the Cataract Power Company to undertake the development of the enterprise. After nearly a year of futile attempts to have the work undertaken at a pressure which would justify them in proceeding with the work, and being unsuccessful, they consulted Mr. J. A. Kammerer, one of the staff of the Royal Electric Company, of Montreal, and after careful consideration of the conditions, and preliminary estimates of cost prepared by him, with a working pressure of 24,000 volts guaranteed, the Royal Electric Company agreed to undertake the work which, with its consequent saving, brought the cost within the limits, deemed necessary by the Cataract Power Company to admit of the enterprise being proceeded with.


MR. WM. KENNEDY, JR., M.C.S.C.E.
Hydraulic Engineer.

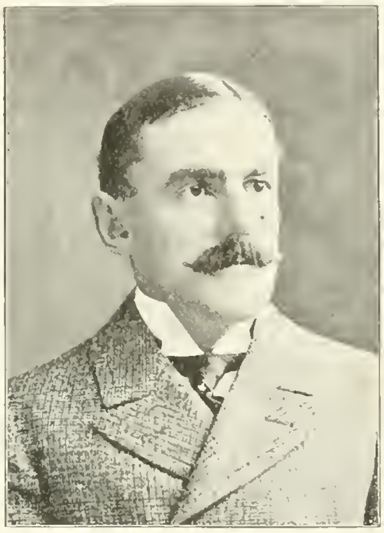
MR. THOS. E. HILLMAN, M.C.S.C.E.
Engineer in charge.

Ground was first broken on October 5th, 1897, and the work pushed with such vigor that the current was sent over the lines from DeCew Falls to Hamilton, on the afternoon of August 25th, 1898, or just 10 months and 10 days from the beginning of the undertaking.

THE CANAL.

The water for this plant is secured through a feeder from the Lake Erie level of the Welland canal at Allanburg. The arrangement of the gates, as shown in Fig. 1, is such as to admit of the unwatering of the lower levels of both the old and the new Welland canals without interfering with the company's supply of water.

From Allanburg the company has a private canal extending northwesterly to the edge of the Niagara escarpment, a total distance of about four and one-half miles. At three different points there are placed gates for regulating or shutting off the supply, so that the water is under complete control. Where the canal crosses the Beaver Dams creek, the water is carried in a closed wooden flume supported on a steel truss. This flume, which is shown in Fig. 2, is placed below the level of the water in the canal at each end so that the contained water is always under pressure, which is intended to prevent leakage. The water follows generally the water courses of a succession of small streams, consequently there are few heavy cuts or fills. In a number of places the contour of the ground formed a natural bed for the canal, and no work was necessary. At the heavy cuttings the banks to the bottom of the canal are pitched with stone, and the important embankments are rip-rapped to prevent erosion.


MR. H. R. LEYDEN,
General Manager Cataract Power Company.

At the lower end of the canal near the mountain top are located three large storage reservoirs, having a total area of thirty-three acres. Two of these, known as lakes Moodie and Gibson, are shown in Figures 3 and 4. These three reservoirs are sufficient to contain forty-eight hours' supply of water, and will meet the hourly inequalities of demand usual in electric supply companies, as well as allowing the unwatering of the upper stretches of the canal for repair purposes, without the interruption of the company's service. Throughout the whole length the work is of particularly substantial character, the factor of safety being exceptionally large, and the requirements of the service seem to have been carefully considered.

The large reservoirs, being located immediately at the mountain's edge where the water enters a steel pipe, the long stretches of slow current canal will, it is expected, promptly freeze over and prevent any trouble from frazil or anchor ice. In this matter the water power is particularly fortunate, as there is practically dead water to Lake Erie. The canal is designed to carry sufficient water to develop from 10,000 to 12,000 horse power without creating an erosive speed in the current. The waterways and appurtenances were constructed by Messrs. Angus McDonald & Company, under the supervision of Thos. E. Hillman, C.E., resident engineer, and under the general approval of Mr. Wm. Kennedy, jr., of Montreal, engineer in chief.

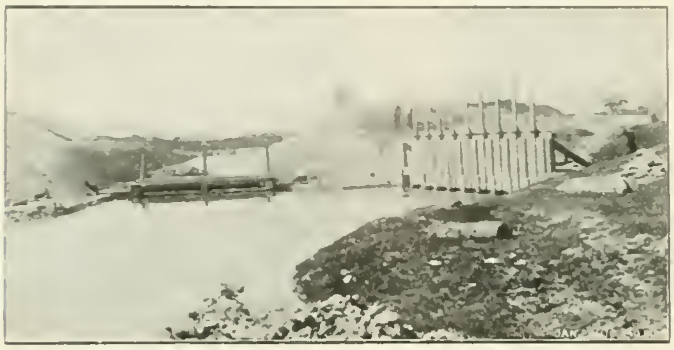


Fig. 1. Arrangement of Head Gates.

THE PIPE.

At the brow of the mountain the water is delivered through a concrete fore bay, protected by suitable racks and head gates, to a large steel pipe which carries it directly down the mountain slope to the power house, two hundred and sixty feet below. The pipe is of steel plate, double rivetted on both longitudinal and transverse seams. It is 745 feet in length and varies in diameter from 8 feet 6 inches at the top to 7 feet 6 inches at the bottom. The steel used for the top section is ¼ inch in thickness and gradually increases in size down the slope until at the bottom it is 13/16 of an inch. The weight of this pipe is all supported from the top, where a number of heavy flanges are built into several piers of concrete placed in the rock cutting. Down the slope, at intervals of fifteen feet, supporting masonry foundations are constructed. A substantial double housing of matched lumber is now being built over the entire length to protect the pipe from extreme changes of temperature.

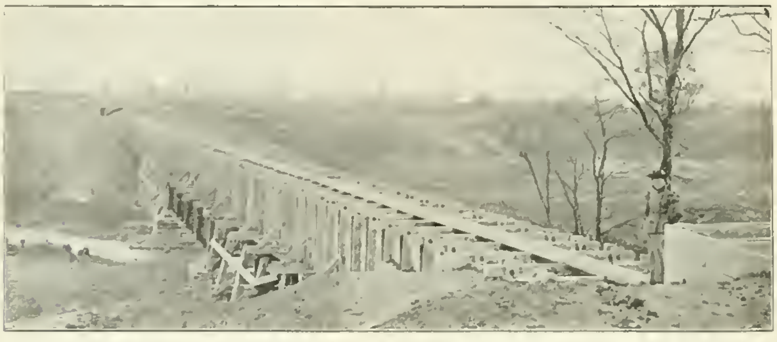


Fig. 2.—Flume over Beaver Dams Creek.

About two-thirds of the way down the slope is placed an expansion joint to take care of any elongation or contraction. In addition to serving this purpose the joint is so designed as to support the part of the pipe below it. This is accomplished by means of the water pressure acting against an annular piston attached to the lower section, the piston working in a cylinder attached to the upper section.

From the top the pipe runs downward at an angle of about twenty degrees for about two-thirds of its length, where it reaches a level bench about sixty feet wide and then continues downward at the same slope to the bottom, where it turns with a gentle curve almost a right angle and extends underneath the floor of the power house.

POWER HOUSE.

The power house building (Fig. 5) is a substantial structure of iron and brick, 174 x 42 feet, with a galvanized iron roof over matched board sheathing. It is designed to accommodate four complete generating units and the necessary step-up transformers, switchboards, etc. Only two units and half the capacity in transformers are at present installed. The building is lighted by clusters of incandescent lights and will be heated by electric heaters.

The main supply pipe enters at the end of the building below the floor level, and inside the building widens out into a steel receiver ten feet in diameter, which is solidly imbedded in concrete underneath the floor. From this receiver four branch pipes come up through the floor with a quarter turn for delivering water to the turbines. In these branch supply pipes are placed large vertical hydraulic gates. These gates are 36" in diameter, and are operated by hydraulic pressure by means of a four way valve, controlled by a lever. These valves will open or close in less than a minute. The gates, as well as all the hydraulic machinery, were supplied by the Stilwell-Bierce and Smith-Vaile Co., of Dayton, Ohio. Beyond each gate valve is placed a 12" spring relief valve, to relieve the pressure when it exceeds that due to the normal static head. The turbines are 1,950 h.p. each, and run at 400 revolutions under the normal head of 280 feet.

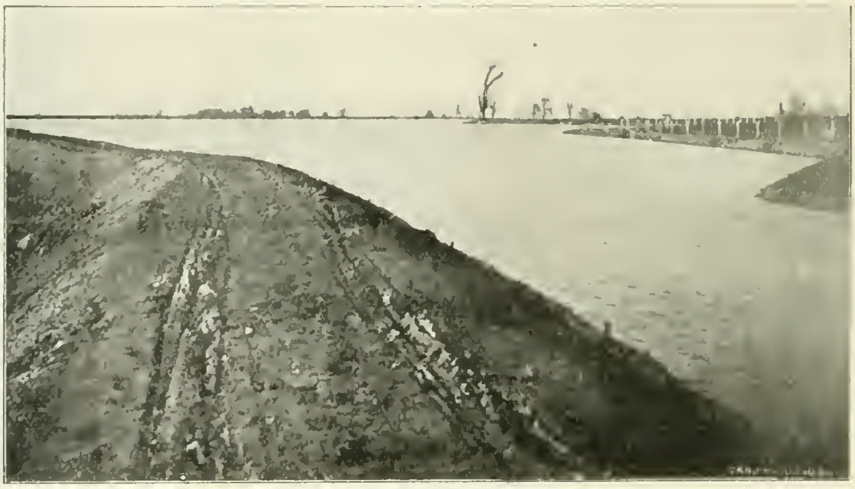


Fig. 3.—Storage Reservoir No. 1—Lake Moodie.

The water wheels are of the inward flow central discharge reaction type, with cylinder gates. We believe that this is the highest head employing this type of turbine, most of the high head plants using the jet or impulse, peripheral bucket design wheels. In order to withstand the unusual pressure, the runners, the gates and all parts susceptible to wear are made of bronze, and everything is made extremely heavy and has been specially designed for this plant. The water enters the wheel horizontally and discharges vertically downward through a draft tube 14 feet in height. Each unit is equipped with a Stilwell-Bierce and Smith-Vaile electric governor of the Giessler design for controlling the speed. On the outer end of the shaft is placed a 7½ ton steel fly wheel with an outboard bearing. The combined influence of the enlarged receiver, the relief valves and the heavy fly wheels is calculated to overcome any tendency to water hammer.

ELECTRICAL EQUIPMENT.

The Royal Electric Co., of Montreal, designed and planned the entire electrical equipment, which marks a long stride forward in the progress of electrical engineering as applied to the transmission of energy. All the electrical machinery and apparatus were supplied by that company, and manufactured at its shops at Montreal, and in character and finish are examples of Canadian manufacture highly creditable. The generators, illustrated in Fig. 6, are of their well-known S.K.C. inductor type, generating two-phase current at 2,000 volts, running at 400 revolutions per minute. Each of the two generators at present installed is of 1,000 k.w. rated capacity. They are connected direct to the turbine shaft by means of an insulated flexible coupling composed of two flanges with projecting pins, the alternate pins being joined by sole leather links. The generators rest on base frames of seasoned Georgia pine to insulate them from the foundations. The inductors of these machines weigh over twelve tons, which weight running at such a high speed, requires most careful workmanship. The entire absence of vibration and general smoothness of operation is certainly creditable to the manufacturers.

Fig. 4.—Storage Reservoir No. 2—Lake Gibson.

The wires connecting the generators to the switchboard are laid in conduits in the floor, which are covered with iron griddles so that they are accessible at any point.

There are two exciters of 30 k. w. capacity, each driven by a separate turbine. Each exciter is calculated for supplying the full equipment of four generators. They are likewise directly connected to and insulated from the turbines. A view of the exciter unit is shown in Fig. 7.

The main switchboard, as shown in Fig. 8, is made up of three white marble panels, one for each generator and one for the exciters. On the generator panels all the connections are made on the back of the board, there being no terminals on the face. The switches are of the S.K.C. slide quick break type and are provided with automatic shutters to prevent arcing. They are double throw, connecting to two separate sets of bus bars so that the machines may be run on separate lines or in parallel, according to the future requirements of the service. Each generator panel contains a volt meter with a double throw switch connected to both phases, an ampere meter on each phase and a direct current ampere meter in the field circuit of the generator. The cases of the instruments are made of ground glass and present a very attractive appearance. The exciter panel contains the usual instruments for operating two shunt-wound direct current machines in parallel, and also contains the synchronizer, which is of the ordinary three lamp type.

A special feature is the absence of generator fuses. As the S.K.C. generators supplied were made especially by the Royal Electric Company to withstand a heavy overload it was considered safer to risk the strain upon the generators due to a short circuit rather than, by the blowing of generator fuses, to cause the instant removal of the entire load from the water wheels.

Immediately back of the switchboard and taking up one end of the building are located ten of a new type of S.K.C. transformers, used to raise the potential relieved by the generators to 22,500 volts on the transmission line, at which pressure it is at present operated. These transformers are arranged in batteries of five, each transformer having a capacity of 200 k.w. They are artificially cooled by means of water pipes supplied directly from the penstock, the pressure being reduced by means of throttle valves. The transformers are encased in tanks made of steel boiler plate and rest directly on the concrete floor. The coils are wound in sections carefully insulated and separated by unusually large air spaces, and the whole immersed in mineral-seal oil. This construction has been found to admirably answer the purpose of this exceedingly high voltage, each transformer being tested with a break down strain of 40,000 volts before being installed.

A novel feature of the installation is the switchboards which accompany each transformer. They are of specially selected white marble and contain two single pole high voltage switches and one double pole 2,000 volt switch, the two high voltages being separated by a marble barrier. The high voltage switches consist of a flexible cable, having a screw plug attached to one end and a socket to the other, the socket being attached to a hardwood pole four feet in length for safe handling. The socket and the plug which it fits over are tipped with non-arcing metal. By means of these specially constructed switches the 22,500 volt circuit can readily be opened. The low voltage switches are of the S.K.C. slide quick break type on the back of the switchboard. Each transformer is also equipped on both the primary and secondary sides with enclosed non-arcing fuses. The 22,500 volt wires inside the building are all covered with a specially heavy insulation of rubber and

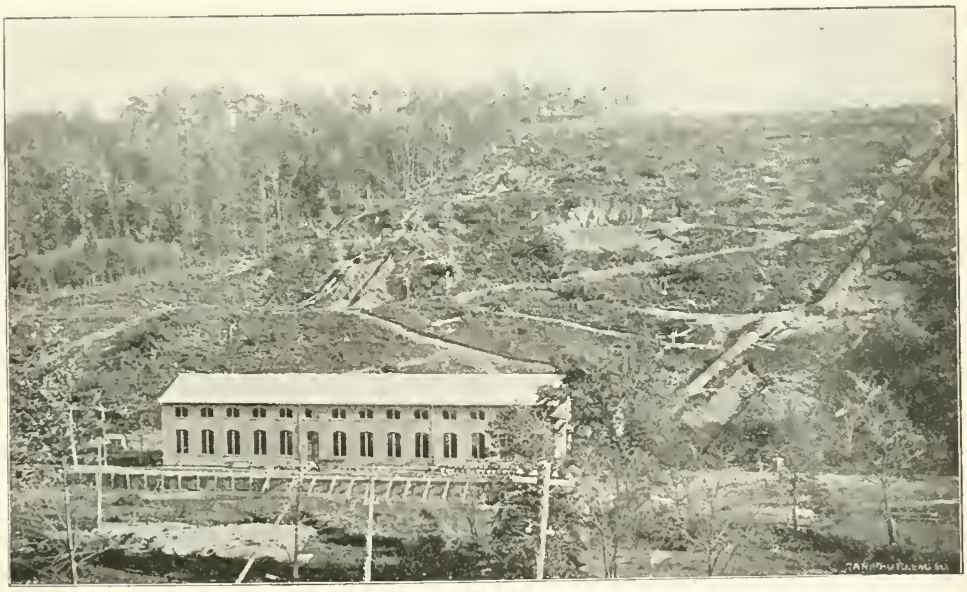


Fig. 5.—General View of Power House and Pipe.

are supported on porcelain line insulators on an overhead rack, all being in plain sight and easily accessible.

From the transformers, which are connected five in parallel on each phase, the circuit runs to the line terminal board, consisting of four high voltage switches similar to those placed on the transformer, except that they have double terminals, in order that they may be changed to either of the two lines contemplated by the company. Immediately above the line terminal board is placed a specially constructed lightning arrester equipment, composed of 60 S.K.C. non-arcing arresters with their special appurtenances and connections. From the lightning arresters the wires pass upward and out through the wall of the building at a height about 30 feet from the floor.

THE TRANSMISSION LINE.

The high voltage wires are carried through the brick wall forming the gable of the power house, by means of lead encased rubber covered cable, protected by vitrified pipe, the cable being kept clear of the pipe by wooden bushings specially prepared in oil. After passing over a cross-arm attached to the building, the lead covered cable is joined to the bare copper transmission wires, by means of a long carefully made water-proof joint. This special construction has proven entirely satisfactory.

From the power house the transmission line crosses the Twelve Mile creek and runs up the hill opposite on private property, to a concession road, thence along this roadway due north to the Grand Trunk Railway and then westward along the railroad right of way on an almost perfectly straight line to the company's step-down station at Hamilton, a total distance of a little less than 34 miles. The transmission wires are four in number, and are No. 1 B. & S. medium drawn bare copper. They are all placed on one four pin cross-arm 3¾ × 5¾″, spaced 18″ apart, and are supported on porcelain insulators of the Redlands type, supplied by the Imperial Porcelain Co. The pins are of special design, holding the insulator two inches higher from the cross-arm than the standard practice. This is to avoid trouble from heavy snow or sleet. The pins are of yellow locust specially prepared in oil and are fastened into the cross-arm with a wooden pin instead of being nailed, so as to use as little iron as possible.

The poles are all specially selected, with 8″ tops and not less than 35 feet in length. They are set 90 feet apart and 6 feet deep in the earth. The height of the poles varies with the contour of the ground, so as to keep the wires as nearly horizontal as possible. In marshy places a crib filled with stone is built around the base of the pole, and where the line crosses the Jordan river the poles are placed in a cluster of piles specially driven for the purpose. On the top of the poles is run a galvanized iron barb wire grounded at every pole by means of an iron plate for lightning protection. Below the transmission cross-arm is placed a two-pin cross-arm carrying the telephone circuit.

The telephone circuit is a complete metallic circuit of No. 10 B. W. G. galvanized wire, transposed at every fifth pole. This arrangement has been found to give satisfactory service with the heaviest currents yet passed over the line.

The insulators were all carefully tested with a breakdown pressure of 60,000 volts, both at the factory and again at Hamilton before being put up, with the satisfactory result that not one has broken down, or produced the slightest trouble in the three months during which the line has been in operation, notwithstanding the unusual rain and sleet storms during that period.

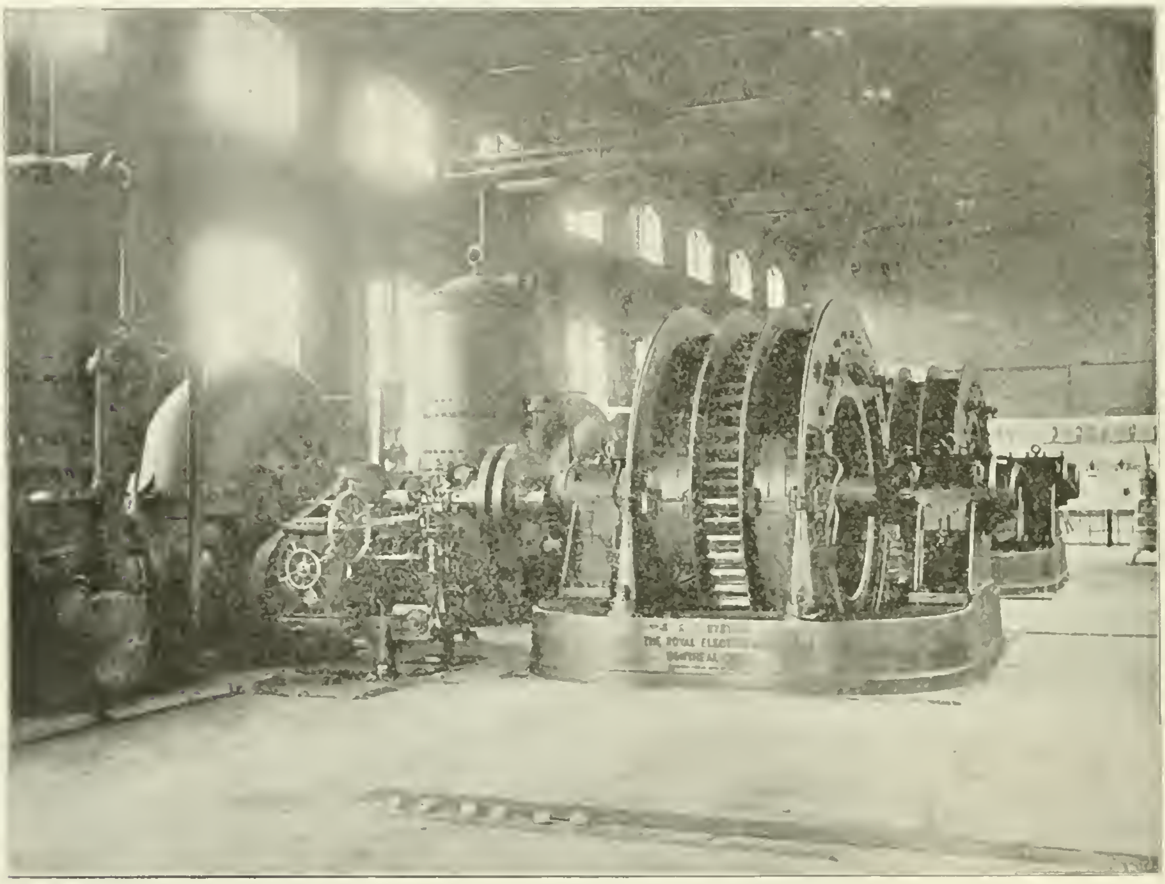


FIG. 6.—INTERIOR OF POWER HOUSE, SHOWING GENERATORS.

The construction of the pole line was executed by Messrs. Lowe & Farrell, of Hamilton, the Cataract Power Company supplying the material. This work has been executed in a very creditable manner.

TRANSFORMER SUB-STATION AT HAMILTON.

The company's step-down station (see Fig 9) is located on Victoria avenue, immediately beside the Grand Trunk Railway's right of way, about one mile within the city limits. It is a neat structure, built of brick, with a slate roof and specially designed for its purpose. At this point the voltage is reduced to 2,000 volts, at which pressure the current is distributed through the city in four separate circuits.

The line wires are carried through the brick walls of the building in the same manner as at the power house. There is the same arrangement of lightning arresters, high voltage lines and two batteries of transformers. The transformers, however, are arranged so as to be artificially cooled at times of heavy load by an air blast. The transformers rest over an air duct in the floor and are provided with a ring of vertical air ducts passing up through the oil. The blast arrangement, which consists of a No. 6 Sturtevant blower, direct connected to an S.K.C. two phase induction motor, delivers air directly into this duct, which then passes upward through the transformers.

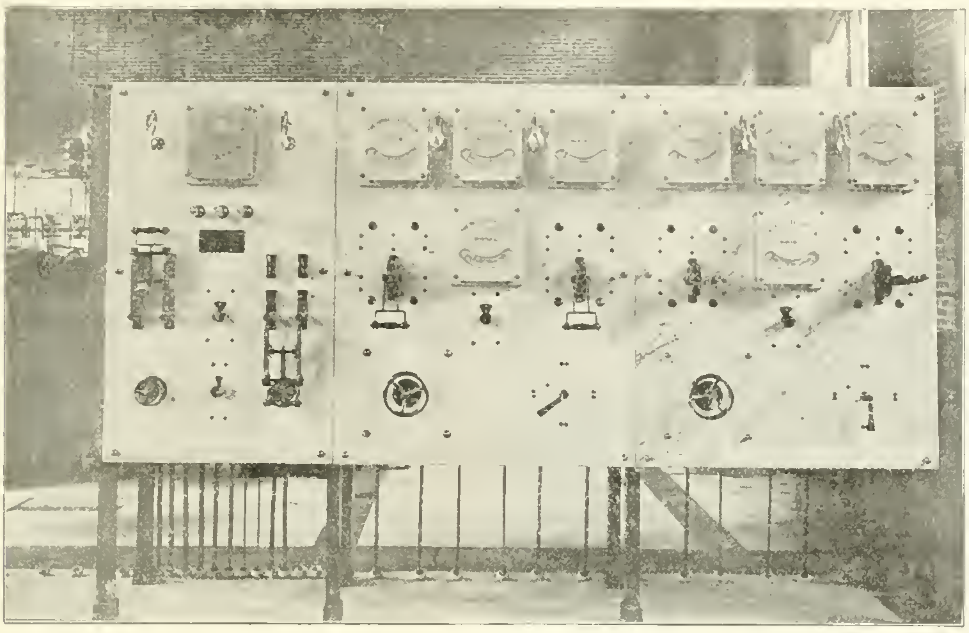


Fig. 7.—Generator Switchboard.

In the transformer room is also placed the distribution switchboard, and, as at the power house, only half the ultimate capacity of the transformers has been installed, the building being designed to accommodate two more batteries of five, similar to those already placed, consisting of four panels each, containing two ampere meters, two double pole double throw switches and four duplex fuse blocks. From this distribution switchboard incandescent lighting current is supplied for the Hamilton Electric Light & Power Company, as well as for motors on premises of customers throughout the city. From the switchboard the circuit wires pass upward to a cupola in the roof, at which point they are joined to the distribution circuits. The line supplying the incandescent service is a four-wire two-phase circuit, but the circuits devoted exclusively to power are composed of three wires only. An interior view of the transformer station is presented in Fig. 10.

At the premises of the Hamilton Electric Light & Power Company is being installed a new circuit switchboard, arranged to accommodate the old single phase lighting circuits of this company. Each circuit is equipped with a double throw switch in order that the load may be divided with a regulating transformer, so that the pressure may be controlled upon this point. The old house-to-house 1000 volt 16,000 alternation transformers have all been replaced by new S. K. C. 2000 volt 8000 alternation transformers in larger units, and the service all changed to this higher pressure in order to reduce the losses and obtain better regulation.

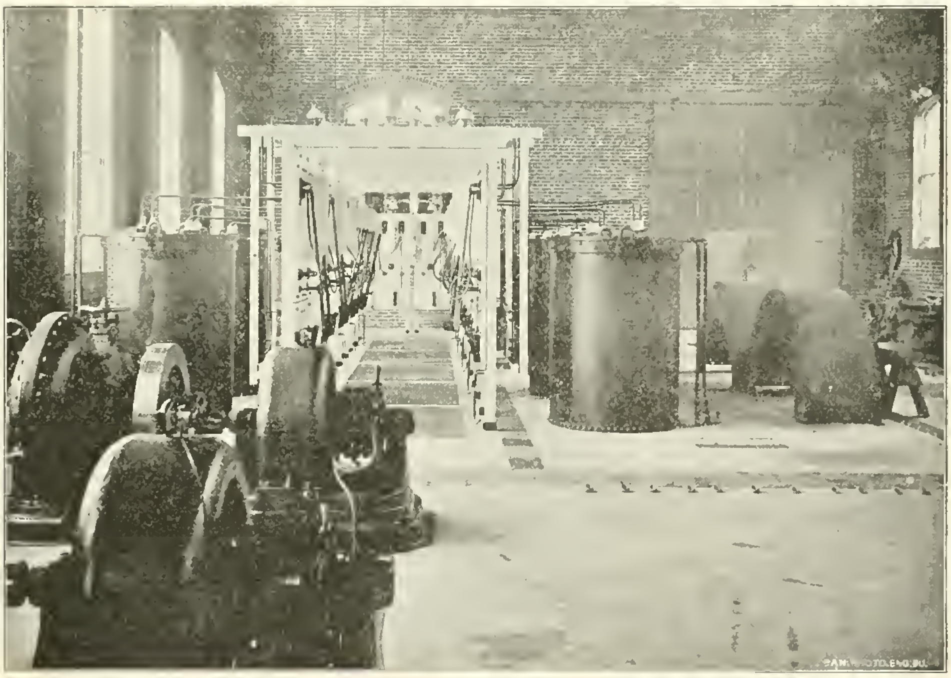


Fig. 8.—High Voltage Switchboard, Step-Up Transformers and Exciters.

In addition to supplying the Hamilton Electric Light & Power Co.'s service, the Cataract Power Company have already contracted for a large amount of power for operating factories of different kinds in the city. They expect within a short time to supply the various electric railways in and about Hamilton and to replace many of the steam engines in the various manufacturing establishments with electric motors.

The plant has been in practical operation for several months, and has thoroughly demonstrated the success of electrical transmission at this high voltage and long distance, which speaks well for the carefulness in designing and construction of the work.

The officers of the company are: Hon. J. M. Gibson, president; James Dixon, vice-president; John Moodie, treasurer; John Patterson, secretary; H. R. Leyden, general manager, the latter having had general charge of all the construction operations. Portraits of these gentlemen, as well as of the other directors of the company, will be found elsewhere in this number.

FORMAL OPENING.

Although the plant above described had been in operation for some time, it was not until Saturday, November 12th, that the formal opening took place. In response to the invitation of the Cataract Power Company, some 200 persons, chiefly business men of Hamilton, gathered at the Grand Trunk station in that city, and were taken by special cars to St. Catharines, where carriages were in waiting for conveying the guests to the power house, about three miles distant. Here an hour was spent in an inspection of the plant, which was running at full speed, after which the visitors were invited to partake of luncheon. Tables had been arranged in the reserve space in the power house. A sumptuous repast was served, and no evidence was lacking that the hospitality of the directors of the company was fully appreciated. The closing down of the machinery signalled that some remarks were forthcoming. Hon. J. M. Gibson, in a few words, expressed his pleasure at being accorded the privilege of presiding upon an occasion which marked the inauguration of so important an undertaking. He announced a brief toast list, which elicited replies from Mayor Colquhoun, Ald. Carscallen, Messrs. A. T. Wood, M.P., T. H. Macpherson, M.P., John Stuart, W. F. Maclean, M. P., Wm. Gibson, M. P., John Moodie and others. Returning to Hamilton about 7 p.m., a visit was made to the transformer station, where further speech-making was indulged in.

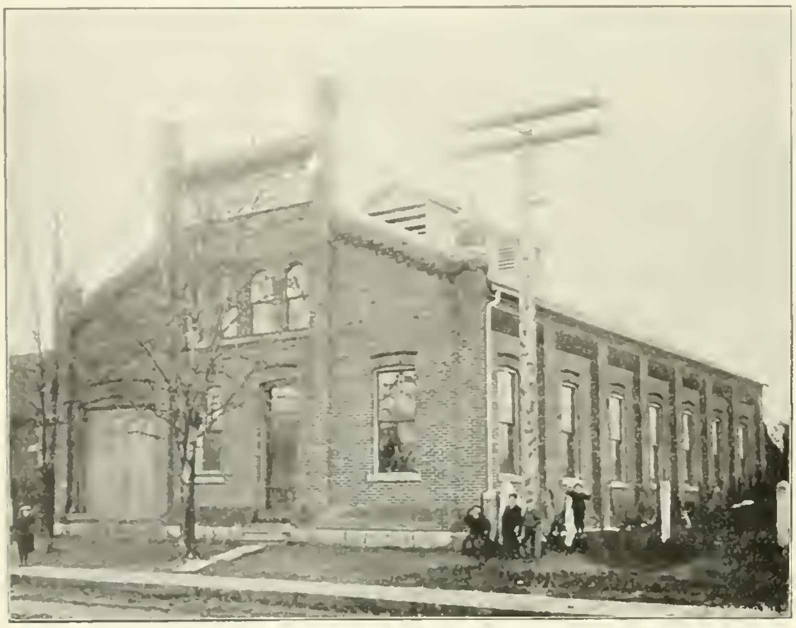


FIG. 9.—SUB STATION AT HAMILTON.

Mr. James G. Pennycuick, of Toronto, has invented a glass conduit for the conveying of electricity without material loss of power.

Mr. H. H. Pratt, Superintendent of Construction for the Central Construction Company, Buffalo, N.Y., was recently in Toronto and called at the office of the ELECTRICAL NEWS. Mr. Pratt informs us that his company are engaged in power plant construction, including water, steam and electric, and that it is the purpose to give greater attention to Canadian business.

Mr. J. J. Wright, manager of the Toronto Electric Light Co., recently visited Fenelon Falls, Ont., for the purpose of obtaining data upon which to base a report regarding the practicability of the proposal for the transmission of electric energy for light and power to Lindsay. Mr. Wright was engaged by gentlemen who have been asked to provide the capital necessary to carry out the scheme.

The annual statement of the Montreal Street Railway Company, for the year ending September 30th, 1898, has been submitted to the shareholders. It shows net profits of $601,704.18, as compared with $507,855.60 for the previous year. This is equivalent to an earning power of 13 % on a capital of $4,700,000. After paying a dividend of 10 %, $138,000 was carried to rest account. The rolling stock was increased during the year by the addition of 22 closed motor cars and 60 open motor cars, all constructed in the company's shops. There are also under construction at the present time 115 cars for next summer's traffic, together with 10 sweepers. The cost of road and equipment construction thus far has been $2,901,959.38, and of equipment $2,093,061.47.

Mr. R. C. C. Tremaine, B.A. Sc., of the Exeter Electric Light and Power Co., in remitting subscription to the ELECTRICAL NEWS, writes: "I am glad you continue it, both on my own account and that of my men, who take great interest in its practical articles."

MONTREAL.

(Correspondence of THE CANADIAN ELECTRICAL NEWS.)

The new theatre, "Her Majesty's," is now open, lit electrically from Lachine power. The switchboard is of the standard Cushing (Boston) type, somewhat similar to that of the Knickerbocker Theatre, New York. Dimmers are interlocking.

As winter approaches, Montreal abounds with the electric belt fiend and similar "parasites." Such articles, of course, prevent everything from consumption to broken limbs. The fools of this city are not all dead yet apparently, as the industry is evidently in a healthy (?) condition.

The Merchants' Cotton Co. are equipping their new wing electrically with 1,000 lights, 21 station watchmans' detectors, and some private 'phones. The work is in the hands of the Montreal Electric Co., who are using Crocker-Wheeler generator and Eco Magneto watchman's detector in their contract.

W. C. McDonald has again been McGill's benefactor in putting his hand in his pocket for new electrical apparatus. This will be greatly appreciated by the new professor of electrical engineering, for although the present laboratory is fitted with good apparatus, yet it cannot be classed as up-to-date by any means.

It is with regret that we learn of the departure of Mr. Gonzenbach, of the engineering staff of the Royal Electric Co. He goes to take a position with the Westinghouse Co. at Pittsburg, where we have no doubt his sterling qualities will commend him. He left numerous friends here, and was well liked by the trade.

At the ball lately given by Mrs. Meighen, 140 Drummond street (formerly the residence of Lord Mount-Stephen), an unique effect of lighting the main staircase and hall was produced with reflectors placed outside of the stained glass windows and ornamental skylight. As the art glass was exceedingly handsome, and the lights not spared, the effect was excellent. The job appears to be in for all time, as the rubber lead encased wire is laid firmly outside the house on the limestone, and does not make an unsightly piece of work either, as the lead makes a fairly good match as regards color to the stone.

That the Electric Street Railway has benefitted Montreal to a great extent cannot be denied, yet some of their arrangements, to those not initiated into their official mysteries, are hard to explain, viz.: The Windsor and St. Lawrence route is apparently the most paying one, and its patrons the most dangerous "kickers" if they should be put to it, and yet every evening cars loaded to the muzzle proceed out St. Catharine street west from down-town, whereas this very traffic could easily be relieved by a few cars run out St. James street west and up the Guy street line, which latter is

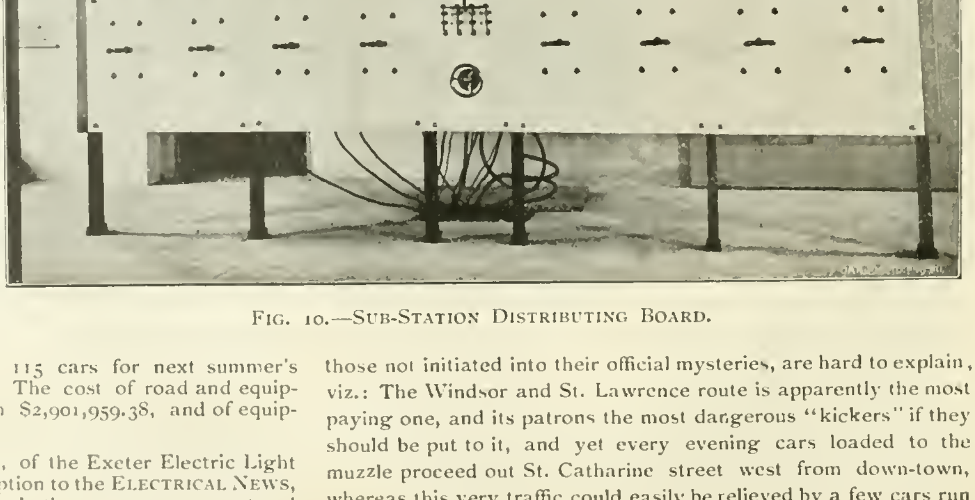


FIG. 10.—SUB-STATION DISTRIBUTING BOARD.

not used to any great extent, and will not be until the government give permission to cross the bridge at Seigneurs street.

The system of supplying current to several installations from one large transformer, although economical from the power company's point of view, can hardly be called a "good thing" just yet. Several houses are wired as per old underwriters' rules, and have no main cut-out; possibly among some of these stands one "up-to-date," yet by being connected with afore-mentioned ones (possibly grounded) the modern installation partakes of the faults of the old ones. As to the installations without main cut-out, what would happen were a short circuit to occur on their interior mains?

MCGILL UNIVERSITY NOTES.

Prof. Owens, head of the electrical department of McGill University, accompanied by the students of the Department, visited Peterborough on the 2nd inst. for the purpose of inspecting the extensive workshops of the Canadian General Electric Company at that place.

Mr. Insull, president of the Chicago Edison Company, has consented to deliver a lecture to the students of the Electrical Department of McGill University about the middle of February. I am not able at present to give your readers the title of the lecture or the exact date of its delivery, but hope to do so later on.

The authorities of McGill University propose to substitute for the degree of B.A.Sc. (Bachelor of Applied Science) that of B.Sc. (Bachelor of Science), as being one more readily understood by the public. The Gazette remarks that the dropping of the word "applied" will also take away the opportunity now afforded (and not altogether neglected) for hostile critics to represent the training in this faculty as merely technical. While the faculty prides itself on turning out professional men as competent as college training can make them, the teaching is scientific in spirit throughout, and is founded on a basis of pure science which takes up a large part of the course.

AN ELECTRICIAN'S LUCK.

A well-known electrician of this city is now the possessor of a gold-headed cane, which came into his keeping in a most peculiar manner. While visiting the Toronto Industrial Exhibition last autumn, he got into the midst of a crowd who well-nigh squeezed each others' life out in an attempt to gain entrance to the grand stand. When the Montrealer emerged from the crush, he was not only surprised to find his bones intact, but also that somebody had come out of the scrimmage minus a gold-headed cane, which, in the absence of its owner, he felt free to appropriate.

ELECTRIC TRACTION ON STEEL RAILS.

ALTHOUGH several more or less important works have already been published under the above title, so far none have treated exhaustively the subject of electric traction as a topic by itself; all have neglected it for the fuller treatment of the widely different questions of energy and distribution to the rolling cars. Many engineers, therefore, who are not satisfied with superficial notions on the subject, complain at not finding, in technical works purporting to deal with the matter, sufficient data touching the conditions to be realized so far as electric motors and rolling stock are concerned.

The recent treatise on "Electric Traction on Rails," by Andre Blondel and Paul Dubois, is intended to fill this want in the electrical literature. In this it has succeeded remarkably, covering the field broadly, not only as to the variety of subjects dealt with, but as to the manner in which the different aspects of each particular subject or development is treated.

This work has been conceived in two main divisions, treating respectively (1) of the rolling stock and appliances in all classes of service, and (2) of the technical discussions of traction proper. The authors have added, as natural complements of the subject, a practical study of the track in the first part, and a careful exposition of the several methods of braking in the second, not only from a mechanical, but also an economical point of view. Two important appendices attached to the first volume treat respectively of the various costs and running expenses, and of the private and public precautions of safety. Numerous indexes added to the second volume give valuable information on specifications, designs of motors and other appliances.

Mr. George H. Cooper, of Oakville, Ont., in remitting his subscription to the ELECTRICAL NEWS, writes; "I find it one o he best mechanical magazines that I have ever read."

CANADIAN ELECTRICAL STUDENTS' COMPETITION.

THE publishers of the CANADIAN ELECTRICAL NEWS hereby offer a first and second prize of $15 and $10 respectively for the best thesis submitted by an undergraduate of a Canadian university on any one of the following subjects, viz.:

1. "The Magnetic Circuit of Dynamos."
2. "The Incandescent Electric Lamp."
3. "The Electric Meter."
4. "The Relative Advantages of Low and High Frequency in an Alternating Electric Lighting Plant."
5. "A Concise Description of a Method of Testing Transformers for Efficiency at Various Loads, both as Regards Regulation and Coal Loss."
6. "Comparison between Two and Three Phase Installations for the Long Distance Transmission of Power."

It is required that each thesis submitted in this competition shall consist of not less than 5,000 nor more than 6,000 words, and shall be written in the third person, and typewritten for publication on one side only of foolscap paper.

To admit of a fair comparison of the merits of the theses which may be submitted, keeping in view variety of subjects, a system of marks will be employed such as is generally used in college examinations, and with which the competitors in this competition are familiar. These marks will be allotted under three heads, viz.:

1. Subject Matter.
2. Arrangement.
3. English.

Taking 100 as the combined total, the maximum and minimum marks for each of the above classifications will be as follows:

Maximum.		Minimum.
50	Subject Matter	25
25	Arrangement	15
25	English	15

If any of the theses submitted should not be entitled to receive the minimum of marks as above, they will be entirely rejected.

There are three sources from which competitors must draw their subject matter, viz., books, periodicals and floating literature, personal or private channels. In judging of the subject matter, the following relative values will be attached to the above mentioned sources of information:

(a) Books	10
(b) Periodicals and floating literature	20
(c) Personal or private sources	20
	50

Where extracts are used, their source and names of authors should be clearly given.

Where diagrams are required to illustrate the text, they should be drawn with pen and perfectly black ink on pure white drawing paper, bristol board or tracing linen, and in such manner as to admit of their reproduction to a small scale.

Each thesis shall be submitted by motto only, and shall be accompanied by the name of the author enclosed in a sealed envelope bearing the same motto. This envelope will remain sealed in the hands of the publishers until the competition shall have been decided.

Theses submitted in this competition must reach the C. H. Mortimer Publishing Company of Toronto, Limited, Toronto, Ont., publishers of the ELECTRICAL NEWS, before the first day of October, 1899.

A competent judge has been chosen to decide the competition in accordance with the method explained above. This gentleman, whose name will be given at a later date, will no doubt be acceptable to all concerned.

The result will be published as soon as possible after the close of the competition.

The publishers of the ELECTRICAL NEWS reserve the right to publish such of the theses submitted as in their judgment may appear to be desirable for that purpose.

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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Long Distance Transmission Plant of the Cataract Power Co.

WE present to our readers in this issue a description, with numerous illustrations, of the Cataract Power Company's plant for the transmission of electrical energy from a point near St. Catharines to the city of Hamilton, a distance of thirty-four miles. The successful completion of this undertaking marks an important point in the progress of electrical development, not only in Canada, but throughout the world, inasmuch as the generating plant is unique in many features. It is not known that turbines are operating elsewhere under so high a head, nor is it believed that current is being transmitted in daily service at so high a pressure. Again, this is presumed to be the longest distance transmission of electrical energy for power purposes in North America east of the Rocky Mountains. On the Pacific coast, where the highest price must be paid for coal, long distance transmission of power is a problem much less difficult of solution. The projectors of this enterprise had to compete with local steam plants using coal costing less than $3 per ton. It was perhaps natural that, in connection with a problem involving so many experimental features, the original promoters should first have applied to the best known foreign engineers and manufacturers for advice as to the practicability of the scheme both from an engineering and commercial point of view. It was less natural that they should have been obliged to fall back on the resources of Canadian engineers and manufacturers It is, however, cause for the highest gratification that these have proved themselves equal to the emergency, and that the credit of successful achievement in so important an undertaking belongs to Canada. The inference is clear that we have the men and the means to carry out the most difficult undertakings, and that until these have failed we should not go abroad for assistance. It is understood that the company's foreign advisers did not see their way clear to employ so high a voltage, owing to which fact the cost of copper was prohibitive. After careful consideration, Mr. Kammerer, the company's Canadian electrical adviser, working in conjunction with the Royal Electric Company, decided that a pressure of from 20,000 to 30,000 volts might with advantage be employed. The large saving thus effected in cost of copper went far towards insuring the commercial success of the undertaking. It is gratifying to learn that the company are not experiencing the heavy loss in their transmission lines which it was predicted would result from the use of high pressure over wires of small cross-section. Another important requisite to the commercial success of the enterprise was that the electrical machinery should be of the most efficient type. This requirement has been successfully met by the Royal Electric Company, of Montreal, with their S.K.C. system. Much credit is due to Mr. John Patterson, in whose mind the scheme found its inception, and to the gentlemen whose portraits appear in this number as officers and directors of the company. These gentlemen pluckily stood by the enterprise through a period of much uncertainty and many discouragements. We join with all true Canadians in the wish that its future success will bring them ample reward. The fact that the Hamilton Electric Light and Power Company, and many other large users of power in Hamilton, have shut down their steam plants and contracted with the company for their power supply, seems to show that in this instance at least the steam engine has been outdone.

Central Station Management.

The business of a lighting company is to furnish light, and not current, as appears to be the view of some. True, the bills are made out for so much current and not for so much light, but there are two parties to the bargain, and a continuance of the arrangement is dependent upon the satisfaction of both. The customer in exchange for his money, which has a pretty definite value, receives light which even in the laboratory is difficult of measurement, and he determines its value by comparison merely. If another premises is better lighted or one portion of his own lighting is better than another, or if his lamps are sometimes at normal candle power and sometimes above, he will use the better illumination as the standard, and any decrease is resented, even when it is just what he is paying for. The success of the company in the customer's eyes is measured by the brightness of the illumination given by the lamp, and this illumination is dependent not only upon the lamp itself, but upon its placing. To achieve the best results the illumination should vary as little as possible, as a continually dim light is less commented upon than if it be alternately bright and dim. This regularity is to be secured not only by a proper voltage regulation, but by choosing lamps which maintain their initial candle power as nearly as possible throughout their life. A poor lamp at start may have the same light-giving efficiency as a better one, or may even have a higher candle power for the same consumption, but its average efficiency throughout its life may be lower. Further, the lamp which gives the highest efficiency averaged throughout its life may not be as satisfactory as one of lower average, for many lamps are on the market which increase considerably in candle power during the first few hours of life and decrease thereafter rapidly, and the customer complains that the high illumination to which he has grown accustomed is not maintained. Of two lamps which commence life with an effective candle power of sixteen, one may rise to eighteen and then fall to twelve, while the other may decrease in a regular way from sixteen to twelve, and the latter will be the more satisfactory on account of its uniformity in spite of the fact that the total light given out is less during its life. Also, in replacing some of the lamps in an installation the contrast between the old and the new will be less marked in the latter case.

The rating of lamps at so many watts per candle at start is only tolerable when recognized as being not an indication of light-giving efficiency, but as a rating, for in the course of its life a lamp which begins with a consumption of 3.1 will increase to 3.5 or to 4 watts per candle—not, mark you, by the increase of current or of watts, but by the decrease of the light given out through changes which affect the light-giving efficiency of the filament and the smutting of the globe. Again, a rating to be of use must be understood to refer to the illumination given out at a specified voltage, as the same lamp may have any consumption per candle power according to the voltage at which it operates. For instance, a 104 volt lamp which gives 16 c.p. with 4 watts per candle, if raised to 108 volts will give about 20 c.p. with 3.5 watts consumption, and if the voltage be raised still further to 112 will give about 25 c.p., or one c.p. per 3.1 watts. It is to be noted, however, that this increase in efficiency is obtained at the expense of the life of the lamp. The essential difference between a low and a high efficiency lamp is that the latter is run at a higher incandescence, and in consequence its life is shortened. It will, however, appear to be giving more light than the former at the same c.p., thus illustrating the fact that the eye is a poor photometer. In consequence of its higher incandescence, the high efficiency lamp is unable to maintain a commercially useful length of life under conditions of variation of voltage, and where they are used the regulation must be correspondingly improved. A 3.1 lamp may be satisfactory where the regulation is within 2%, while for a 4% regulation it will be necessary to use 3.5 watt lamps, and for 6% variations a 4 watt consumption or higher will be advisable. It will be seen, therefore, that without great sacrifice of life a great saving in consumption may be made by the use of higher efficiency lamps, which is made possible by better regulation. This will be to the benefit both of the customer and the station, for the former will have decreased lighting bills, while the latter will be able to increase its output without extra cost for either new plant or running charges of the present. These are benefits which will appeal to every manager, and he naturally asks what price there is to pay for the better regulation which is responsible for this increased efficiency. The price in most cases is not large; it involves apparatus for indicating in the station the state of things at the lamp and the proper lay-out of feeders and distributing mains, and close attention in the station to the regulation. Many stations have plenty of copper in place, but not in the proper place, and an intelligent study of the existing conditions will indicate where that copper should be located. Having arranged the circuits intelligently, the station attendant is kept in touch with the voltage at the lamps by means of pressure wires to the centres of distribution or by means of a compensating volt meter adjusted to the feeder drops. If in addition a recording volt meter be used at the distributing centre, the manager is in a position to check the attendant and the chain is complete.

The above remarks are of more interest to the steam station manager where running costs are higher and speed regulation better than in water power stations, but only in degree, not in kind, as he will push lamp efficiency higher than would be advisable in the latter case to save coal at the expense of the small loss due to the shorter life of the lamp. To sum up, a large saving of energy, which is costing you money, may be made by keeping your voltage as constant as possible and using lamps of an efficiency to correspond, and by a simple system of testing the lamps to ascertain that those you purchase maintain their candle power as nearly as may be possible about their initial during the period of their life.

TWELFTH ANNUAL BANQUET OF STATIONARY ENGINEERS.

Thanksgiving Eve is awaited with some eagerness by the engineers of Toronto, as it has become synonomous with a general hand-shaking and feasting of the members of Toronto No. 1, C.A.S.E., and their friends. This year the invitations announced that the dinner would take place at the Walker House. The accommodation there provided, coupled with the unceasing effort of the dinner committee, fully maintained the reputation of Toronto No. 1 in the direction of providing social entertainment. Four tables, nicely decorated, had been provided, two extending lengthwise of the large dining hall and one across each end. These, however, were found insufficient for the large number of persons present, and a fifth table had to be arranged in the centre. The duties of chairman were performed in a most efficient manner by Mr. Charles Moseley, president of the association. Among those present, there were noticed the following :

Mayor Shaw ; Ald. S. H. Woods ; C. H. Rust, city engineer ; Prof. Galbraith, principal School of Practical Science ; A. G. Horwood, secretary Toronto Technical School ; Alex. Fraser, secretary Boiler Inspection and Insurance Co.; A. E. Edkins, inspector Boiler Inspection and Insurance Co.; J. S. McKay, traveller Robb Engineering Co.; George Anderson, manager Royal Oil Co.; James McLaughlin, traveller Queen City Oil Co.; William Sutton, manager Wm. Sutton Compound Co.; C. L. Weeks, General Engineering Co.; A. M. Wickens, chief engineer parliament buildings ; James Sinclair, manager Eureka Mineral Wool Co.; E. G. Fowler, boiler inspector ; Geo. Grant, George Grant & Co., oil merchants ; W. G. Blackgrove, inspector Boiler Inspection and Insurance Co.; George Clapperton, Bennett & Wright Co.; F. H. Powers, traveller Vacuum Oil Co.; James Litster, manager Pure Gold Manufacturing Co.; Wilson Phillips, late mechanical superintendent T. Eaton Co.; R. C. Pettigrew, executive vice-president, Hamilton ; George Mackie, Robert Mackie and J. Ironsides, Hamilton ; John Huckley, Waterloo branch ; G. C. Mooring, chief engineer Methodist Book Room ; E. J. Philip, chief engineer T. Eaton Co.; John Dixon, engineer new city hall ; W. J. Webb, engineer Lawlor estate building ; H. E. Terry, engineer R. G. McLean ; J. W. Marr, engineer Metropolitan Railway Company ; James Huggett, chief engineer Freehold Loan building ; John Fox, engineer O'Keffe Brewing Company ; J. G. Bain, engineer Toronto waterworks ; T. Eversfield, engineer Toronto University ; George Thompson, engineer T. Eaton Co.; W. Bourne, Toronto Electric Light Co.

The menu was all that could be desired, and after the appetites of the guests had been appeased, some opening remarks were made by the chairman. After welcoming the guests, Mr. Moseley referred to the progress which the Stationary Engineers' Association had made. The various reports of the officers and the unanimous good feeling which prevailed among the members was, he said, a source of congratulation. The present condition of affairs demonstrated the ability of those who had preceded him in office. The opportunities afforded the members of the association of improving themselves in the various branches of engineering were each year becoming more extended, and those opportunities, united with tenacity of purpose, would no doubt result in greater advancement in the future, so that each might extend his sphere of usefulness to the betterment of the condition of his fellowmen.

After the singing of the National Anthem, the chairman proposed the toast of "Toronto, Our City," coupling therewith the names of Mayor Shaw and Ald. Woods. In replying, Mayor Shaw congratulated the association upon the large number present, which, he thought, was one of the strongest evidences of prosperity. He referred to the encouragement which was being given to manufacturing industries, to the deepening of the canals, and to the improvements to Toronto harbor, expressing the hope that at an early date ocean vessels would come as far as Toronto. He understood that the engineers were endeavoring to secure a license law from the Ontario government, so that no man would be allowed to take charge of an engine unless he held a certificate of competency. Incompetency, he said, not only endangered the lives of those having charge of an engine, but life in general. His remarks were greeted with applause. Ald. Woods, being called upon, expressed feelings much in sympathy with the engineers. He was in favor of organized labor, and it had been a great pleasure to him to have been of some service during the past year to one or two members of the association.

Following came the toast of "Canada, Our Home." Mr. George Anderson, manager of the Royal Oil Company, in responding, stated his belief that we had entered on an era of prosperity in Canada which would continue for many years. He hoped to see the number of chimney stacks doubled in this country, and pointed to the wonderful agricultural, industrial and mining development. He deprecated strikes, and was pleased that the Canadian Association of Stationary Engineers was an educational society, as undoubtedly there was room for mechanical improvement. Mr. Anderson concluded by telling some humorous stories, and was followed by Mr. A. M. Wickens, who referred to the question of elevators for the new city hall, stating that he was such a thorough Canadian that he would not purchase American elevators. We had a number of things in Canada to be proud of, and Canada should also be proud of the C.A.S.E., as it had established the Toronto Technical School. Engineers were getting a greater salary to-day as a result of their connection with the association. They had become more valuable to their employers.

With the toast of "The Manufacturers" were coupled the names of Mr. C. L. Weeks, of the General Engineering Company, Mr. James M. Sinclair, of the Eureka Mineral Wool Company, and Mr. James McLaughlin, of the Queen City Oil Company. Mr. Weeks said that when we left school we had only learned how to study; then it was a question of application. He referred to the necessity of efficient employees. In their manufacturing business two forms of competition had been experienced. One of these was the cutting of prices below the point where good machinery could be produced ; the other was infringement of patent rights. In this connection the speaker incidentally referred to the suit now pending between the General Engineering Company of Canada and the American Stoker Company. The latter, he said, had infringed upon their patents in respect to mechanical stokers. Mr. Sinclair made a few pointed remarks, stating that many of the factories in Toronto were working day and night. The increase of factories would necessarily result in the employment of a larger number of engineers. Mr. McLaughlin, responding to the same toast, said that trade and commerce had lifted up the human family to its present eminence. The story of the growth of manufacturing was not alone the story of freedom, but the record of civilization, and the best evidence of freedom and well doing was the ring of the anvil and the hum of the wheels of industry. The manufacturers, by their skill, have given cheaper and better products and added to the material welfare of the people. Canada certainly possessed advantages from her abundance of iron, copper, coal, nickel, lumber, and minerals of all kinds, but one disadvantage was the small population, scattered over such a vast country, 3,600 miles from east to west and 1,400 miles from north to south. He believed that a prosperous manufacturing industry in Canada could only be established by cultivating the markets of the world at large and by developing the agriculture of the country. Within the last few years an acceptable change had placed Canadian manufacturers on a fair footing with those of other countries. An opinion prevailed until recently that home-made goods were not equal to those imported, but to-day the products of Canadian manufactories were beginning to be appreciated, and in the markets of Europe they were taken in preference to goods of a similar kind from other countries. Touching briefly upon the oil industry, Mr. McLaughlin said that all were aware of the great difficulty there had been heretofore to obtain a good oil, either illuminating or lubricating, manufactured from Canadian crude material. To-day the oil manufactured at the Sarnia refinery defied competition either in illuminating, lubricating, or other fine products of petroleum. The Queen City Oil Company, which he represented, had recently expended a very large sum of money in the erection of a thoroughly equipped refinery at Sarnia, which he believed was one of the best on the American continent. Other Canadian manufactories had also demonstrated their capabilities. Figures were given showing our imports and exports. In 1888 we exported manufactured goods to the value of $4,161,282; in 1897, $9,522,014. In 1895 our total imports of all kinds were $110,781,682, and our exports $113,638,803. In 1896 our imports were $118,011,508 and our exports $121,013,852. In 1897 our imports were $119,218,609 and our exports $137,950,253, or $18,741,644 more than we imported, which was $16,000,000 in excess of the previous year and $27,000,000 in excess of the fiscal year 94-95. Therefore, he thought we had every reason to congratulate ourselves on our prosperity, our country and our manufactories.

Prof. Galbraith, principal of the School of Practical Science, and Mr. A. G. Horwood, of the Technical School, responded to the toast of "Our Educational Interests." The former stated that this year the attendance at the School of Science and the Technical School was larger than ever before. He was fully convinced that the C.A.S.E. were following the right course in encouraging education. They were justified in using every means to improve their position. He referred to the proposal to bring Niagara power to Toronto, pointing out that it would not be in the interests of engineers, and humorously alluded to the proposal of Mr. Nicolas Tesla to transmit power without wires from Niagara Falls to New York, and even to the European continent. Mr. Horwood pointed out the relation between technical schools and the manufacturers. The British manufacturers found that Germany was capturing their trade, so the British government established technical schools after the policy of Germany, and now they were getting their trade back again.

The toast of "The Executive" was next proposed, Messrs. E. J. Phillip and A. E. Edkins, past presidents, R. C. Pettigrew, vice-president, and Geo. C. Mooring, treasurer, responding. Coupled with the toast of "Sister Societies" were the names of Messrs. John Dixon, president Toronto No. 18, G. Mackie, vice-president of the Hamilton association, and John Huckley, of the Waterloo branch. Each of these gentlemen spoke briefly. Mr. Dixon thought that the association should take some steps to provide for aged members of the association. The toast of "The Press" was responded to by Mr. S. J. Robertson, of the Canadian Engineer, and Mr. T. S. Young, of the ELECTRICAL NEWS AND ENGINEERING JOURNAL. At this juncture Mr. Mackie proposed the toast of "Toronto, No. 1," which brought forth a reply from the president, Mr. Charles Moseley. Mr. Moseley said that the association had been of great benefit to him personally, having assisted him in an educational way. The object of the association in earlier years had been to lay a good foundation, and to-day they possessed a good library, hall, and every necessary accommodation. The toast list being concluded, the dinner was brought to a close by the singing of "Auld Lang Syne." The following gentlemen furnished the evening's musical programme: Messrs. W. G. Blackgrove, Bert Harvey, J. Litster, James Fax, Geo. W. Grant, W. H. Banfield, and E. Fisher, the latter acting as accompanist.

The dinner committee consisted of: J. Marr, chairman; George Thompson, secretary; George Mooring, treasurer; A. M. Wickens, J. Bannan, Albert Slute, W. C. Tait and J. G. Bain.

BARE WIRES AND ALTERNATING CURRENTS.

THE following letter from the city electrician of Winnipeg, Man., explains itself:

WINNIPEG, October 3, 1898.

MR. F. M. MORSE,
Secretary Winnipeg Electric Street Railway Company.

DEAR SIR,—I understand that it is the intention of the Winnipeg Electric Street Railway Company, operating the North-West Electric Company, to use the network of bare wires, forming the mains of the distributing system in connection with their proposed new system to be installed some time during the coming winter.

I further understand that it is the intention of the Winnipeg Electric Street Railway Company to employ on the aforesaid bare wires "alternating currents," using the mains as a three-wire secondary network, fed from transformers, the primaries of which, I understand, will have a difference of potential of something over 2,000 volts.

I consider that the above system, using bare overhead wires in the streets of this city, will be highly dangerous, both to life and property. It is a well-known fact that the insulation in transformers frequently breaks down, thus placing the secondaries in direct connection with the primaries; should this take place there will be a pressure of 2,000 volts between the secondary wires and the ground, forming a short circuit as soon as another ground is caused on the opposite side of the alternating circuit. Should this take place in even one transformer, the whole bare wire system, extending over miles of streets and connected to hundreds of private premises, would be thus affected.

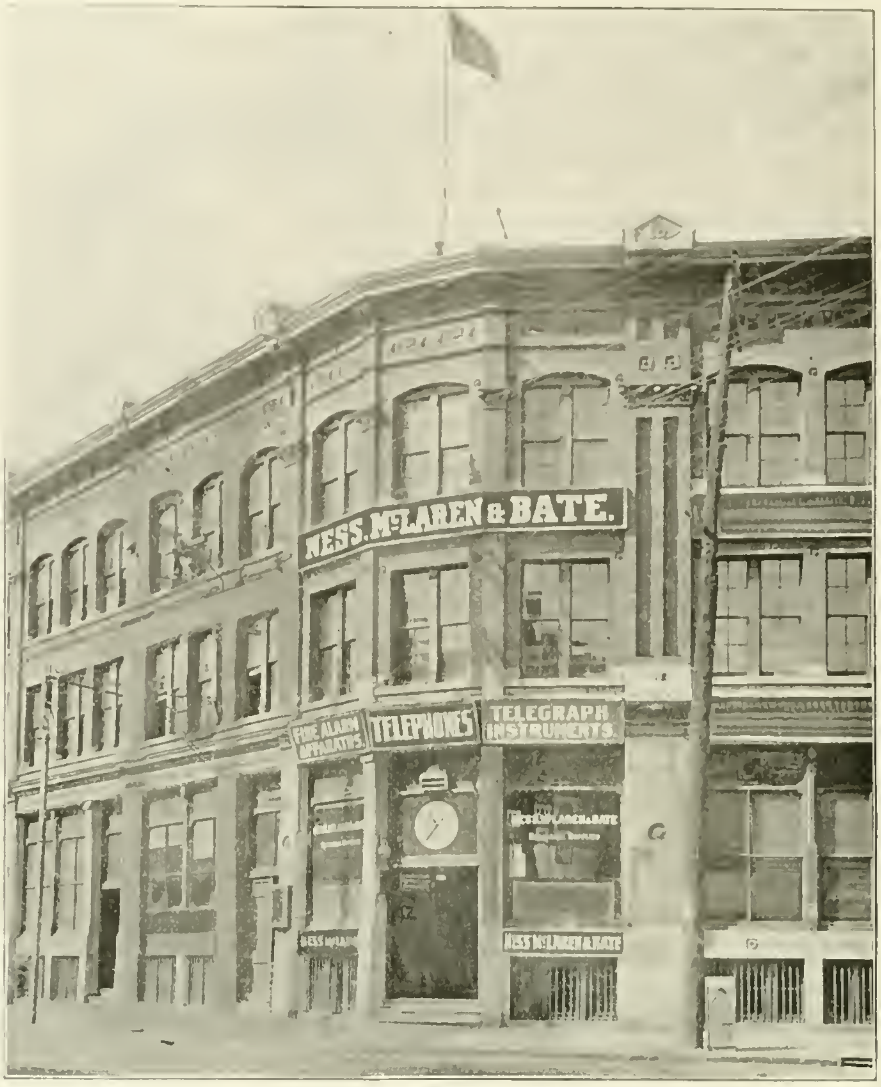
This proposed system being thus radically different from that for which the city council authorized the use of bare wires, viz., the Edison direct current system, leads me to unhesitatingly condemn this proposed system of distribution for electric lighting in this city.

At the time of installing the North-West Electric Company's system, the representation was made as to the voltage of the direct current to be used, not to exceed 220 volts, and further that there would be a protection with guard wires on each side. This latter element of safety, I find, has not been provided.

I desire at this time to call attention to the matter so as to obviate extra expense being caused you, as I certainly would have to object to the system proposed to be used, or, to use other words, to the use which is proposed to be made of the bare wires of the North-West Electric Company's system.

Yours truly,
(Sgd.) F. A. CAMBRIDGE,
City Electrician.

MESSRS. NESS, McLAREN & BATE, MONTREAL.



It will be remembered that last spring the factory of Messrs. Ness, McLaren & Bate, at 740 Craig street, Montreal, was seriously damaged by fire, necessitating their removal to new quarters. These were found at the corner of Craig and Seigneurs street. In their new premises they put in a complete plant of special tools and machinery for the manufacture of telephones, telegraph instruments, annunciators, switchboards, fire alarm apparatus and electrical supplies of various kinds, and they now have one of the best equipped and most modern factories in Canada. A view of their premises is presented on this page, and on the following pages will be found glimpses of the interior of their factory, office and show rooms.

Messrs. Ness, McLaren & Bate advise us that at the present time they are busy in every department, and are doing almost double the volume of business which they were one year ago. Among their staff of employees there are a large number of experts, and the goods turned out are considered standard, it being the aim to make only the best quality.

STEAM BOILERS AND FROST.

Among the enemies which threaten the destruction of steam boilers, says the Journal of the Bavarian Society for the Inspection of Steam Boilers, frost is by no means the least formidable. The following two examples go to show that even boilers built of heavy plate and tested at high pressure cannot be exposed to the rigors of cold weather with impunity.

The boiler was, because of the scarcity of orders during the winter months, fired only two or three times per month, each time for several days, and was the rest of the time allowed to stand idle, filled with water. One fine day when the boiler, which consisted of upper and lower boiler, was being emptied and put in readiness for an inspection of the interior, it was found that the manhole cover in the rear head of the lower boiler had been forced out and the rim of the manhole badly rent and bent out of shape.

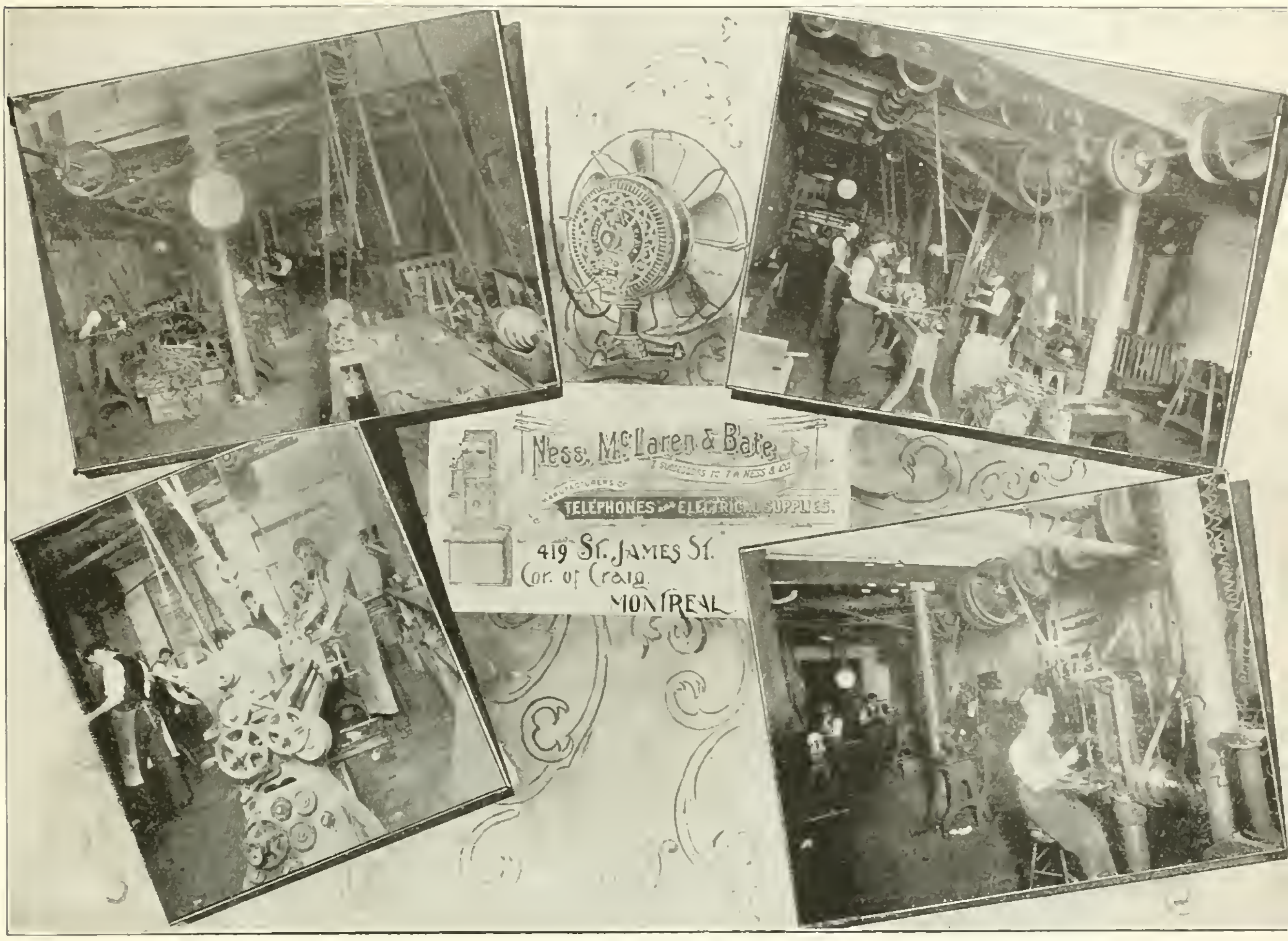
Further examination revealed a cone of ice behind the damaged boiler head. The water in the upper boiler, which was at the proper level, was covered with a crust of ice about one centimeter, 0.4 inches thick. There could be no doubt that the ice cone in question had caused the damage, the mass of ice, in freezing from the outside toward the interior, having found sufficient hold on the heads of the rivets and irregularities of the flue to cause the pressure developed by the final freezing of the core of the cone to act, instead of toward the free interior, upon the head of the boiler, until the latter gave way and became rent at its weakest point — the unfortified rim of the manhole. The process of destruction was favored by the fact that the door leading from the boiler-house into the open air was only a short distance from and directly opposite the unprotected boiler head.

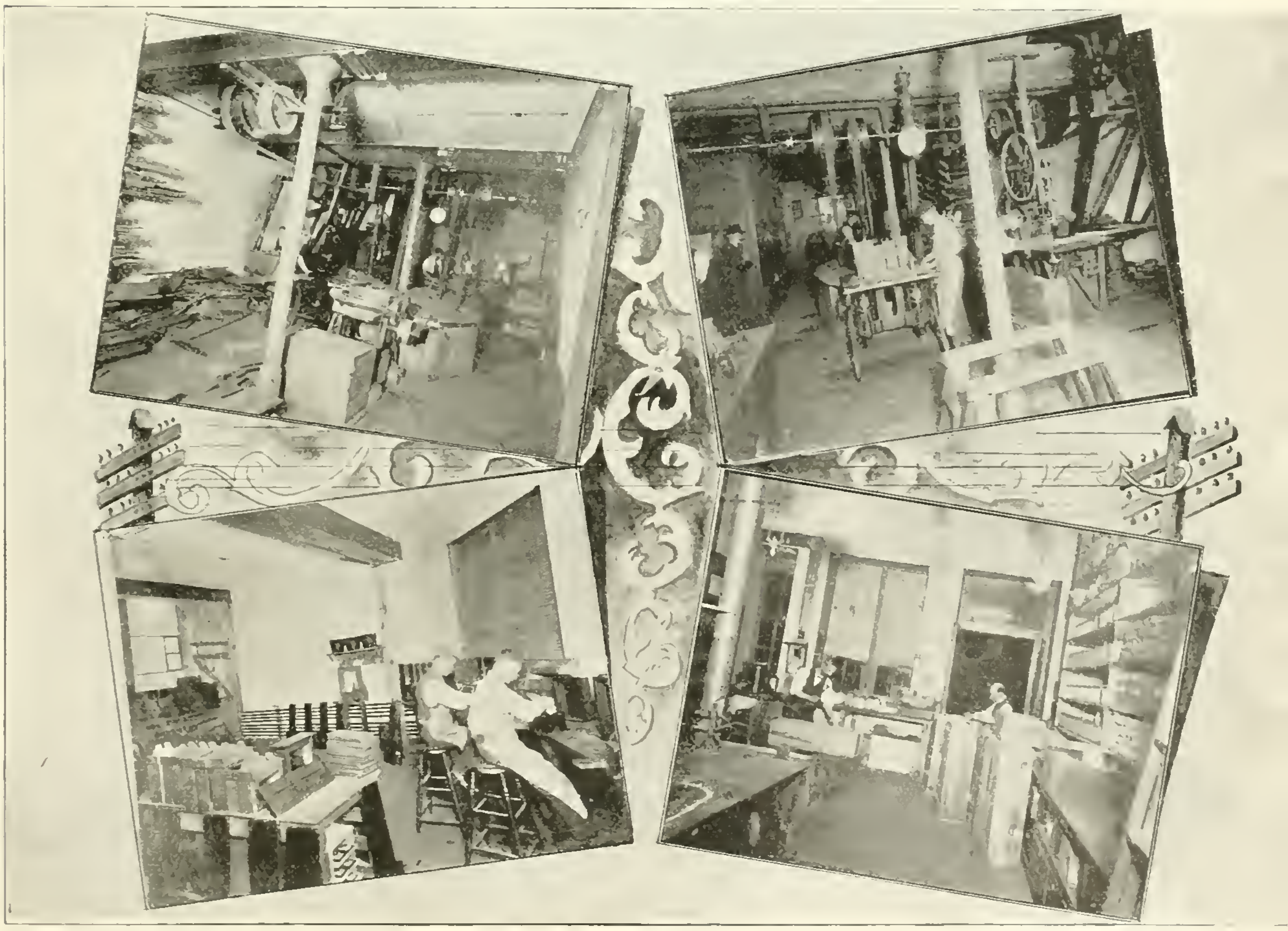
Another boiler, which was used only once a week, was situated in a small stone building in the middle of the farmyard.

When on a certain winter day the boiler was to be heated, it was noticed that it was rent from the mud-hole of the cross-tube along the lengthwise seam to a point beyond the fourth rivet, but that no water flowed from the rent. On opening the man-hole over the crown of the fire-box it was found that the water between the shell and fire-box, as well as in the cross-tube, had frozen, and this at once explained the cause of the damage. The cylinder of ice which had formed in the cross-tube had pressed against the shell of the boiler and had caused it to burst along the seam — its weakest spot.

These two examples demonstrate that boilers which are little used and exposed to the cold must be protected in winter against freezing, and this is effected best by discharging the water or by maintaining on cold days a light fire under the boiler or in the boiler-room.

The number of periodicals dealing exclusively or largely with electricity amounts to sixty-six. Of these eighteen are published in France, fourteen in the United States, twelve in Germany, six in England, three in Switzerland, two in Austria, Belgium, Holland, Italy and Spain, and one in Canada.





INTERIOR OF FACTORY OF MESSRS. NESS, McLAREN & BATE, MONTREAL.

Office and Show-Rooms of Messrs. Ness, McLaren & Bate, Montreal.

QUESTIONS AND ANSWERS.

"G.W.V." asks: What horse power motor would be required to run two one-inch shafts, one 82 feet and the other 48 feet in length, at a speed of 560 revolutions per minute, No. 1 shaft running 40 sewing machines and No. 2 shaft 20 sewing machines.

Answer.—A four horse power motor would be economical for doing the above work. A three h.p. motor might do it, if the shafts were in good shape and there was no excessive friction.

"Subscriber," Perth, Ont., writes: Kindly advise me if it is possible to change a 50 ampere 1000 volt primary Thompson-Houston alternator to run on a 2000 volt primary, without the use of step-up transformers. Can this be done by changing the connections on armature, say from multiple to series? How can I use transformers wound for 1000 volt primary, 50 volt secondary, on a 2000 volt circuit? Would it be safe to use them on a 2000 volt circuit, using 100 volt secondary, or would it be better to couple two together?

Answer. If the dynamo is wound so that one-half of the coils are connected to the other half in multiple for 1000 volts, it can be easily changed to 2000 volts by connecting the two halves in series. If the coils are already all in series, it cannot be done. You can easily see by examining the connections whether the coils are all in series or not. The transformers should run on 2000 volt primary and 100 secondary if the insulation is good enough. Modern transformers are usually wound and insulated so as to run either way. If your transformers are old and the insulation deteriorated, a doubling up of the E.M.F. may burn some of them out.

PERSONAL.

Mr. John S. Craig has been appointed electrician to the Toronto Fire Department.

Mr. John W. Keeley, the inventor of the Keeley Motor, died at his home in Philadelphia on November 18th, after a brief illness. Mr. Keeley was 61 years of age.

Mr. J. K. Ross, B.A.Sc. (McGill), who was recently appointed assistant engineer of the Birmingham Street Railway, has gone to England to enter upon his duties.

Mr. L. R. Carmichael, lecturer in mathematics and electrical engineering in Queen's University, Kingston, Ont., was recently married to Miss Jenkins, of Strange, Ont.

Mr. P. F. Hodgson, railway signal engineer for the Grand Trunk Railway, has resigned his position, to accept the management of the Saxby and Farmer Engineering Works, of London, Eng. Mr. Hodgson will assume his new duties in January.

Mr. F. A. Wunder, travelling representative for New York State and foreign countries for the Fort Wayne Electric Company, of Fort Wayne, Ind., was in Toronto last month in connection with the tendering for an electric light plant for the city.

SPARKS.

The Prescott Electric Light Company, of Prescott, Ont., is announced to have assigned to W. T. Scott.

The Ottawa Electric Company have completed a new flume in connection with their power house, the cost of which was $5,000.

The Northern Electric & Manufacturing Company, of Montreal, has been authorized to increase its capital stock from $50,000 to $1,000,000.

A company, represented by Dennis Murphy, of Ashcroft, B.C., purposes supplying West Vale with electric power, utilizing the waters of the Thompson and Bonaparte rivers.

The cars of the Hull & Aylmer Electric Railway Company have been equipped with new head-lights. Five lamps of 16 candle power are placed together before a strong reflector.

The Ottawa Electric Company has just installed what is claimed to be the largest electric light dynamo in Canada. It is of the Westinghouse type, and has a capacity of 10,000 lights.

The Bell Telephone Company is erecting a new exchange building in the city of London, Ont. It is said that this exchange will be one of the most complete in point of equipment to be found in Canada.

The council of the municipality of Rossland, B.C., have accepted the proposition of the West Kootenay Power & Light Company to furnish arc lights of 2,000 candle power, at the rate of $96 per lamp per year.

Tenders are invited by the town of Sherbrooke, Que., for lighting the streets by arc and incandescent electric lights. The date limit is December 15th. C. W. Cate is chairman of the lighting committee.

A company of Chicago and Eastern capitalists is being formed, with a capital of $10,000,000, for the purpose of building electric railways in Japan. The name of W. D. Eastlake has been mentioned in connection with the scheme.

"I say," said Fuddles, who sometimes thinks he is smart, "what sort of fruit can you raise on an electric plant?" But Faddles, who also thinks he is smart occasionally, promptly replied, "Currents,"—Washington Star.

It is reported that a New York company have taken an option on the plant and charter of the Canada Electric Company, of Amherst, N.S. Should the purchase be made, it is probable that the new proprietors will increase the capacity of the plant.

Mr. Hartley Gisborne, M. Can. Soc. C.E., of Winnipeg, is reported to have been appointed by the council of the Institution of Electrical Engineers, London, England, their honorary secretary and treasurer for Canada, vice Prof. Carus-Wilson, late of McGill University, resigned.

The Ottawa Electric Co., Ottawa, Ont., are increasing the arc lighting capacity of their power station, and have placed an order with the Canadian General Electric Company for one of their two circuit automatic regulating "Brush" arc dynamos, having a capacity of 125 arc lamps.

The West India Electric Company, of which Mr. Henry Holgate, late of Montreal, is manager and chief engineer, expects to have 22 miles of electric railway in operation at Kingston, Jamaica, by next spring. The principal stockholder in this country is Mr. James Ross, of Montreal.

Messrs. Cornell Bros., of Stanbridge East, P.Q., are installing an electric lighting plant, and have purchased for their requirements, from the Canadian General Electric Company, a 400-light dynamo of the latest M.P. type, together with marble panel switchboard and wiring supplies.

The Montreal Belt Line Company have adopted a novel method of lighting their railway to Bout de l'Isle. An arc light reflector is located on the vestibule of the car, which does the work of a powerful search light, the smallest objects being visible to the motorman a quarter of a mile ahead.

An American inventor has submitted a scheme to the Toronto Street Railway Company to prevent overcrowding of street cars. His proposal is to fit up the cars with movable chairs, which close up automatically when not in use, and when in use increase the seating capacity by economizing space.

The arbitrators in the case of the Laurentide Pulp Company and the province of Quebec, regarding water power at Shawenegan Falls, Que., have given their award. The company are to pay the sum of $5,000 to the province, in consideration of which they will control all rights and privileges for all time to come.

Mr. A. L. Breithaupt, president of the Berlin and Waterloo Street Railway, recently made an inspection of the fender as employed on the Guelph Street Railway. He announced himself as well satisfied with its operation, and is said to have placed an order for a supply of fenders for the Berlin and Waterloo road.

On the invitation of the directors of the Canadian Electric Light Company, a number of the leading citizens of Quebec and Levis visited the company's water power at the Chaudiere Falls recently. Mr. H. M. Price, who is largely interested in the company, acted as guide, and explained to the visitors the extent of the power. The distance from the feed-head to the foot of the falls is 110 feet, while the drop is 94 feet.

The largest locomotive engine ever built in Canada has just been completed at the works of the Kingston Locomotive & Engine Company, Kingston, for the Intercolonial Railway. The driving wheels are 72 inches in diameter, the boilers designed to carry a pressure ot 180 pounds to the square inch, the water tank will hold 3,000 gallons of water, and the tender nine tons of coal. The engine weighs 70 tons and the tender 44 tons, making a total weight of 144 tons.

In the Exchequer Court December 5th will be heard the argument in the suit of the General Engineering Company of Ontario vs. the American Stoker Company and the Dominion Cotton Mills Company. This is a case of an injunction granted to restrain respondents from using certain improvements in mechanical stokers, of which appellants claim the possession of the patent rights. They ask an injunction against defendants that they be prohibited from using such improvements, and be ordered to surrender them, as well as pay damages for infringement.

The Ottawa Electrical Association has taken on new life, and at a meeting held last month Mr. W. M. Wier was elected secretary, in lieu of Mr. E. Bailey, who has removed to Perth. Several members were initiated and a committee appointed to arrange for technical papers and a programme of entertainment. The association has adopted a unique and appropriate crest. The letters "O.E.A." are mounted on a horse-shoe magnet which rests upon a bank of clouds, with streaks of lightning flashing in all directions, the whole being emblematic of electricity and magnetism.

The official announcement has been made of the amalgamation of the Quebec, Montmorency & Charlevoix Railway Company, the Quebec District Railway and the Montmorency Electric Power Company. The company, which will be known as the Quebec, Montmorency & Charlevoix Railway Company, announces its intention of electrifying the road running from the city of Quebec to Cap Tourmente, a distance of about 30 miles, and to construct an independent branch to Montmorency Falls. The estimated cost of the proposed improvements is given as $330,000, and when completed the system will comprise over 60 miles of electric railway, which will be one of the most extensive systems under one management in Canada. Mr. Edward A. Evans, C. E., is general manager and chief engineer of the consolidated system.

The Welland-Vale Mfg. Company, of St. Catharines, Ont., have increased their factory buildings and are making a change in their lighting plant. They have heretofore operated a direct current two wire system, but have decided to keep pace with the times and for this purpose are installing a 600 light alternating current two-phase S.K.C. plant, which will operate on the three-wire system, giving them a much cheaper distribution, as well as the benefit of having an inductor type dynamo, which, they believe, possesses a great many advantages over those of the old type. They are following in the lines of the Penman Mfg. Co., of Paris, and the Cockshutt Plow Co,, of Brantford, who have replaced their direct current incandescent plant by inductor type machinery.

The new electric light plant at Tilbury, Ont., owned by Mr. R. H. Smith, was put in successful operation on the 14th October, and is, we learn, giving entire satisfaction. The station is a one story brick building, 36 x 26 feet, with engine room 35 x 15 feet, and boiler room 11 x 35 feet. The power equipment consists of a 60 inch by 12 feet tubular boiler, Northey steam duplex feed pump and heater, and Leonard-Ball automatic high speed engine. The electrical apparatus comprises two 15 k.w. Edison bi-polar 125 volt dynamos, operating on the three-wire system, with white marble switchboard and full complement of instruments, and one 35 light Reliance dynamo and polished skeleton switchboard and necessary instruments. There are in use 13 arc lights for street purposes and over 300 incandescent lights. The plant, which was installed by the Canadian General Electric Company, is in charge of Mr. Joseph H. Ward, who for some time was superintendent of the St. Mary's electric light plant.

The Edison Electric Company, in New York, has just decided to make an experiment which may result in a wonderful increase in its business, as well as in revolutionizing the domestic economy of many homes. The company has reduced the price for domestic lighting to three-fourths of a cent an hour for each incandescent lamp of 16 candle power, the offer to be good for three months, with a promise to make yearly contracts at that rate. If the people show a disposition to adopt electricity in place of gas which will warrant it, the low rate will be made permanent. Not only does the company purpose invading the field of domestic lighting, but it will offer special inducements to those who desire to use electricity for cooking purposes, even though such use at the best price which can be made would be a luxury at present. Nevertheless, the company displays a complete electric kitchen in its office, where practical demonstrations are made of the various appliances for cooking and heating.

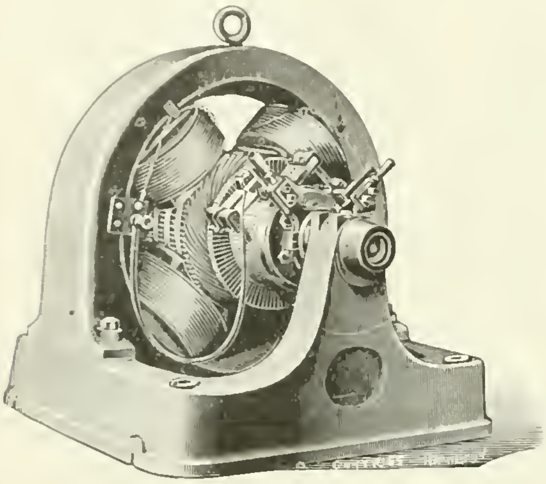
The Parry Sound Electric Light Company, of Parry Sound, Ont., has just completed the installation of new water wheels, purchased from Charles Barber, of Meaford, Ont. They comprise two 42-inch improved Canadian turbines, horizontally set. Work was commenced in September, a pit being blasted out of the solid rock some ten feet to the south of the old mill building; a stone foundation was built around the wheel pit to support the bulkhead, and rock bolts were carried up through this foundation to secure the floor of the bulkhead from any possibility of shifting its position. A floor of 12-inch timber was placed across the foundation, and on this the bulkhead, 8 x 16 feet and 18 feet high, was erected. A draft tube, 5 feet 6 inches long, extends from the floor of the bulkhead down into the wheel pit, and, being air tight, the water, in falling through it after leaving the wheels, exerts as much force as the same amount of water would if above the wheel. The speed of the wheel shaft being 128 revolutions per minute, and the proper speed of the line shaft 15 revolutions per minute, it was necessary to belt from a 72-inch pulley on the wheel shaft to a 28-inch pulley on the line shaft. The connection is made by a double leather endless belt 20 inches wide and 64 feet in length, supplied by the J. C. McLaren Belting Company, of Montreal. At present the head of water is 21 feet, and the wheels are developing about 200 horse power. The work was carried out under the superintendence of Mr. W. H. Train, of Burk's Falls.

HIGH CLASS GENERATORS AND MOTORS.

In order to meet the growing demand for direct current electrical machinery of a higher order of excellence than that heretofore usually offered, the Toronto and Hamilton Electric Company, of Hamilton, have prepared designs for a line of machinery which is claimed to embody the most modern features of correct electrical and mechanical construction. Regarding these machines the manufacturers say: In these the highest possible efficiency is obtained compatible with moderate speeds, and their output is based on a low temperature rise. Careful attention has been given in the matter of correct saturation of the armature teeth, while the density of the remainder of the magnetic circuit is such as to require a minimum current for excitation and least loss in compounding against armature drop and reaction.

The reluctance of the air gap is reduced and a proper distribution of the flux is obtained by the use of a correctly shaped pole shoe, and as a result the brushes do not spark under different loads.

The energizing coils are circular in form, and their careful and even winding results in a high insulation resistance and affords the most economical ratio of turns to weight and length. The armature coils are form wound and thoroughly insulated, and the winding is perfectly symmetrical and balanced. The commutator is massive, made from the best copper, and wholly insulated with mica. Mechanically, the machine is unsurpassed. The armature is built on an open-work hub, which allows of thorough ventilation, and the commutator is directly keyed to same hub, the two forming a unit independent of the shaft, thus eliminating all strain at the armature leads, which often obtains in some types of machine by commutator working loose on the shaft.



The shaft is of the best machinery steel, generously proportioned and carefully finished, and runs in gun metal bearings of the self-oiling and self-aligning variety. The pedestal seats are bored at the same operation with the poles, the pedestals being carefully turned to suit, and this construction insures perfect concentricity of the armature and field magnet, and a regular air gap, important matters in a multipolar machine. The yoke crown is of soft cast iron, the magnet limbs of round wrought iron, and the pole shoes of cast steel, a combination which practice has shown to give the best results for either generators or motors, and to possess the finest regulating qualities.

The excellent balance, generous weight of metal and low centre of gravity insures the smoothest attainable running qualities.

The accompanying cut clearly illustrates the general outline of the belted machine as made in sizes ranging from 7½ to 30 kilowatts, the same being of course suitable to direct connection, their capacities being based on a speed consideration.

The Richelieu and Ontario Navigation Company purpose installing a new electric light plant in the steamer Richelieu. Her boilers and engines will also be overhauled.

SPARKS.

The ratepayers of the town of Liverpool, N.S., has voted in favor of expending the sum of $31,000 for installing an electric light plant and waterworks system.

The city council of Toronto, Ont., has requested the street railway company to make a trial of various fenders, with a view to the adoption of the one found most efficient.

The town of Neepawa, Man., has deferred the installation of its electric light and telephone plant until next spring. An electrician for same has not yet been appointed.

Sir Charles Ross, president of the West Kootenay Light and Power Company, states that it is the intention to make further improvements and additions to the plant next year.

The town council of Cornwall, Ont., is considering the question of putting in apparatus for operating the waterworks by water power. Mr. Weller, C.E., is acting as consulting engineer.

Mr. James Johnston, electrician of the Department of Public Works, Ottawa, is preparing plans for an electric light plant to be installed at Kingston, Ont., for lighting the graving dock.

The time for receiving tenders for an electrical power transmission plant for the town of Orillia, Ont., has been extended to December 10th. Mr. Roderick J. Parke is consulting engineer.

Tenders for the installation of electrical power for operating the locks, bridges, etc., and lighting the Soulanges canal, closed at the Department of Public Works, Ottawa, on December 1st. The result has not yet been learned.

Directors of the Lake Megantic Electric Light Company, Lake Megantic, Que., have been elected as follows: Rev. Father Choquet, president; Dr. Codiere, secretary; L. Becigneul, treasurer; C. A. Leger, managing director.

The ELECTRICAL NEWS was last week favored by a visit from Mr. T. C. Frenyear, manager of the Buffalo office of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa. The Buffalo office of this company is now located at 782 Ellicott Square.

The lectures on "Steam and the Steam Engine" at the Toronto Technical School are now given on Thursday instead of Friday evening. This change has been made in order that the large lecture room on the first floor may be used, as well as the electrical apparatus for illustrating.

Judge Davidson has dismissed the case of Albert Besner vs. Montreal Street Railway Company. The plaintiff claimed $280 damages on account of the killing of his horse and injuries to himself. The court held that the company was not to blame, as the car was slowing up when it neared Gabriel street, and stopped within sixty feet. It was shown that the plaintiff was driving rapidly and tried to cross the track, instead of remaining on the south side of the street, where there was a vacant space of over 19 feet.

Mr. James Ross, vice-president of the Montreal Street Railway Company, returned from England recently. Speaking of electric transportation, he stated that the overhead system has become to be generally accepted in Great Britain, the cities of Glasgow and Liverpool each having several miles in operation. Dublin and Bristol are also to have trolley lines. As to the Birmingham system, in which Mr. Ross is financially interested, little progress has been made. The people have not yet decided what course to pursue.

The city of Hull, Que., received the following tenders for lighting the streets by sixty arc lamps: Ottawa Electric Company, 1,600 c.p. lamps, $49.50 each per year, or 2,000 c.p. lamps at $65 each; Hull Electric Company, 2,000 c.p. lamps, $62.50 each per year. The council decided not to accept either of these tenders, but to obtain estimates of the cost of installing a municipal plant. Mr. Farley has submitted to the council the desired estimates, which show that a complete plant of sixty arc lamps, with poles, wires, etc., would cost $4,938. The improvements of water power on Bowery Creek, including water wheels, flume and building, is placed at a cost of $4,060, and the running expenses of the plant at $2,075. It is probable that tenders for a plant will be invited, although the Hull Electric Company claim that in the year 1894 they were given the exclusive right to furnish electricity in Hull for a period of 35 years.

Owing to the small number of tenders received by the city council of Toronto for the installation of a municipal electric light plant, it has been decided to accept none of the tenders. From the tenders submitted it was found impossible to arrive at even an approximate cost of an electric plant. No tenders were received from Canadian manufacturers. It will be remembered that in the year 1894 similar tenders were asked for by the city, and bids were submitted by fourteen firms. The Bertram Engine Works Company were the lowest tenderers for engines and the Brush Electric Company for dynamos and lamps. In this case, as in the present instance, no further steps towards the establishment of a plant were taken. In this connection we observe that the Anglo-American Electric and Supply Company, represented by Messrs. H. M. East, G. P. Magann, Dr. R. A. Pyne, M.P.P., and G. S. Ransom, have made a proposition to supply electric energy to the city. The company ask similar privileges to those enjoyed by other companies, the right to use the street for carrying wires, and generally the powers necessary and incidental to the carrying out of an electric lighting power and supply business. Power is offered at cost after paying a dividend of 10 per cent. to the shareholders upon a capital stock of $5,000,000. It is guaranteed that the cost to the public will not exceed one cent per horse power per hour.

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—AND—

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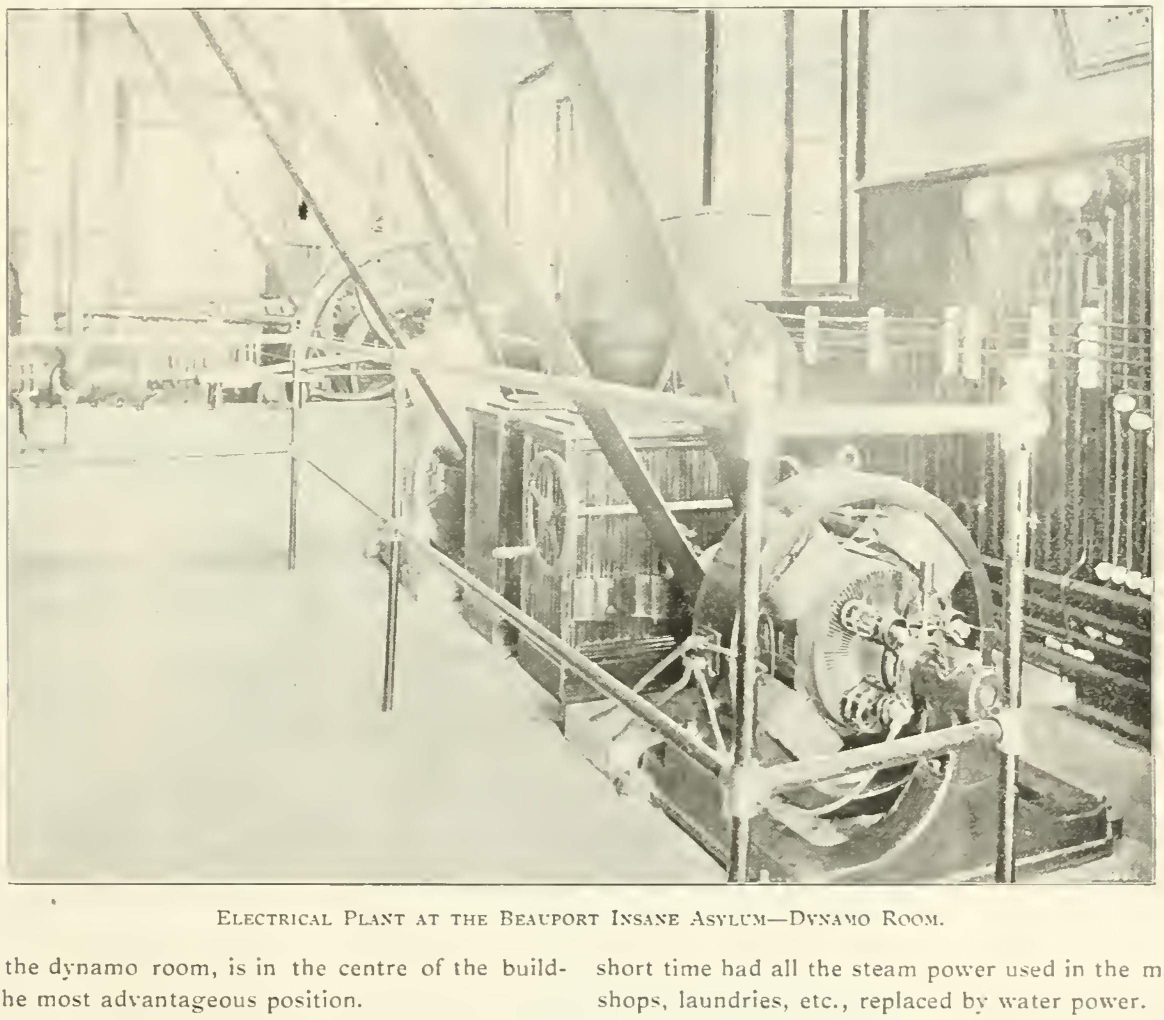
ELECTRICAL PLANT AT THE BEAUPORT INSANE ASYLUM.

JUST outside the city of Quebec, at the Beauport Insane Asylum (L'Asile d'alienes de Beauport) an unusually complete electrical plant of small size has recently been installed, a description of which may interest some of our readers. The Beauport Asylum grounds cover an area of about 140 acres, upon which there are fourteen different buildings, eleven of these being supplied with electric light. The boiler house, a part of which forms the dynamo room, is in the centre of the buildings, the most advantageous position.

A noteworthy feature of the installation is the extreme flexibility of the generating plant, which renders the lighting system practically infallible, a point which has very great significance in an institution where lunatics have to be dealt with.

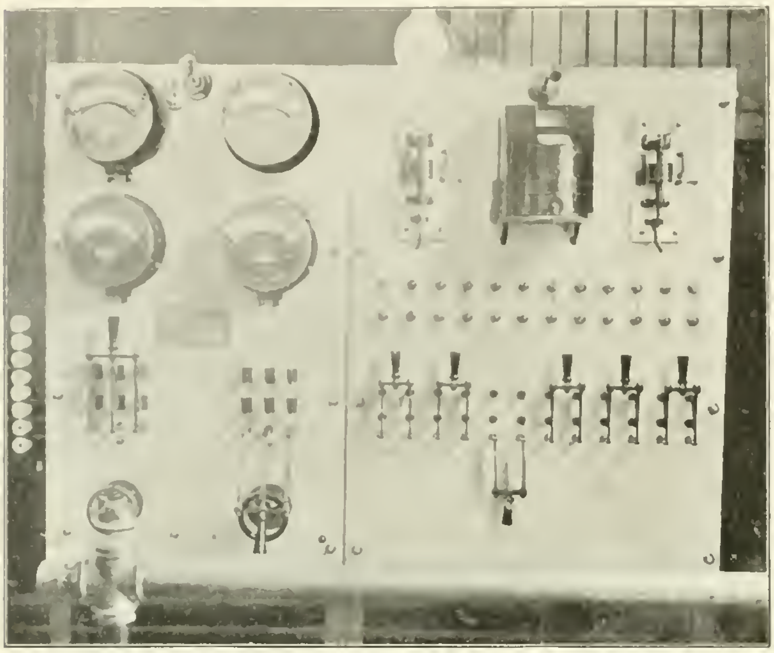
The generating plant is operated by water power, and is in duplicate throughout, with the exception of the steam engine, which is held in reserve as an auxiliary and at the same time is used as a "booster" during the heavy load, the water supply being limited and inadequate for driving the machines under full load. This water power is brought through an underground iron pipe for a distance of four miles, from a large lake which is at an altitude of 300 feet above the grounds upon which the buildings of the institution are located. This pipe is eight inches in diameter for the first two miles and six inches for the remaining distance, and was never intended for any other purpose than an ordinary household water supply, the question of power other than for fire purposes never having been taken into consideration. But upon the advent of the present engineer, he, having had considerable experience in hydraulic work, at once realized the power in store, and in a short time had all the steam power used in the machine shops, laundries, etc., replaced by water power.



ELECTRICAL PLANT AT THE BEAUPORT INSANE ASYLUM—DYNAMO ROOM.

The water wheels are of the Pelton type, designed and built on the premises to suit the local conditions. On account of the success attained with these wheels, the management of the institution was led to ask for an engineer's report on the practicability of utilizing this power to light the various buildings on the grounds with electric light. The coal gas system in use was in need of costly repairs, and was also accompanied by a considerable amount of danger in an institution of this sort.

The illustration on this page is a view of the dynamo room, showing the arrangement of the dynamos, waterwheels and the engine. The dynamos are of the slow-speed Johnson type. The belts going from the pulleys on each machine and the steam engine are connected to the line shaft on the ceiling. As will be seen, the dynamos are directly connected to the shafts of the water-wheels by means of flexible couplers.



Electric Plant at Beauport Insane Asylum.—Switchboard.

Under ordinary conditions it is necessary to run only one machine, but very often it happens that both of them are required. For this purpose, the machines were arranged with equalizer connections brought back onto the middle poles of three-pole main switches, which may be seen on the machine panel of the switchboard, just above the rheostat wheels. The second illustration is of the marble switchboard.

At all times when the two dynamos are running together, they are belted to the line shaft, which serves as a very simple and reliable regulator as regards the equalizing effect between the two machines. This is the case whether one machine is being run by water and the other by steam, or whether both are being run by water. In the latter case, of course, the engine belt is free. The engine is always ready to run, summer and winter, as the boilers are used to generate the steam for cooking, heating and laundry work.

One water-wheel is provided with a governor, which was also designed and built by the engineer; but this governor is used only during the day when the water pressure is unsteady, on account of the varying loads on other wheels on the premises. At night, when other wheels are not in use, the water pressure is absolutely constant, and once the gate is adjusted for the normal load, it is very little trouble for the attendant to keep the voltage steady. As the load is very near a constant one, the amount of regulation necessary is practically nil. Great pains were taken to make as nearly perfect an installation as was possible, and only the best of apparatus was used throughout, including Weston instruments and T. H. watt-meter.

The circuits are so arranged that should a main fuse blow on any one of them, the fuse terminals may be bridged immediately till the fuse is replaced, unless it is that the mains themselves become short-circuited, which event is highly improbable on account of the substantial character of the outside construction.

The wiring throughout all the buildings is cleat and knob work, with the exception of the main portion of the women's building, which is done in moulding. The whole wiring system is most elaborately laid out as regards the distribution of switches. Each ward is so arranged that one or more lights may be turned on from either end. The completeness of this switch system may be imagined when it is stated that the total number is equal to one switch to every two lamps installed. Leaving out the workshops, stables and laundries, the proportion of switches is equal to every one and one-one-third lamps.

The arrangement of the electric irons in the ironing room of the laundry is shown in the third illustration. In the laundry department there is an equipment of sixteen eight-pound domestic irons of the American Heating Corporation's make, and it is claimed that about twice as much work is accomplished daily since the adoption of this system.

Electric Plant at Beauport Insane Asylum.—Ironing Room in Laundry.

The chapel after illumination is an exceedingly pretty and artistic feature of this installation. For this purpose 13 volt miniature series lamps are used in many colors, and the rich effect they give when lighted is one not easily forgotten.

In the spring this plant is to be made even more complete by the addition of quite a large storage battery to carry the night load and to take the place of the second machine and engine during the heavy load.

The entire plant as above described was contracted for and installed by Mr. Edward Slade, of Quebec, upon whom it reflects much credit. It is one of the most interesting small installations yet carried out.

QUESTIONS AND ANSWERS.

"SUBSCRIBER" writes: "I am in charge of an alternator stamped by its makers 40 amperes, 1,040 volts. As I understand it, one ampere on primaries gives 20 amperes on secondaries; if so, 20 × 40 = 800 amperes, total secondary capacity. Now, some electricians calculate on 104 volts, ½ ampere per lamp, others 6 amperes to 10 lamps. The one would give 1,600 lamps, the other 1,440 lamps capacity. This must be wrong, for the manufacturers only claim 800 16 c.p. lamps as the total capacity of the machine. Will you kindly give me the proper system of figuring out a machine's capacity, also what size of wire should be used for primaries, it being 1,500 feet from machine to centre of distribution? Our transformers are banked in pairs, operating on a three-wire secondary system. What size of wire should be used to give the highest efficiency?"

ANSWER.—You are making a serious error in your method of calculating the machine capacity. If you desire 20 amperes on the secondary for each ampere on the primary, you must have a "transforming ratio" of 20 to 1. This will give you 52 volts secondary pressure. If, on the other hand, you desire 104 volts secondary pressure, your transforming ratio must be 10 to 1, in which case you will have only 400 amperes on the secondaries, not 800; so that you will see that in your calculation you are multiplying a 20 to 1 ratio amperage by a 10 to 1 ratio voltage, thus getting, of course, a very wrong result. Whether you get 20 secondary amperes to every primary single ampere or not is a matter that depends on your transformers. It is not usual to-day to use 52-volt lamps; therefore, assuming you use 104-volt lamps, and have therefore 104-volt secondaries, with a transforming ratio of 10 to 1, the method of calculating your machine capacity is as follows: The primary capacity is, of course, 40 × 1,040 = 41,600 watts. The secondary capacity, as you probably know, is the same number of watts, but with different volts and amperes. Using 104-volt secondaries, divide 41,600 by 104, and the quotient 400 is the total secondary amperage (because 104 × 400 = 41,600 watts). How many lamps this 400 amperes will allow depends on the kind of lamp. You are aware that you can purchase in the market lamps requiring 3, 3½ or 4 watts per candle power, or per 16 c.p. lamp requiring 48, 56, or 64 watts. Probably the 3½ 56-watt lamp is what you use. This lamp takes 56 ÷ 104 amperes, or .538 amperes. The total number of lamps that the machine will supply can therefore be calculated by dividing 400 by .538, with the result 743 lamps. A 4 64-watt lamp would similarly require 64 ÷ 104 = .615 ampere, giving 400 ÷ .615 = 652 lamps. And again, similarly, a 3 48-watt lamp would require 48 ÷ 104 = .461 ampere, giving a total capacity of 400 ÷ .461 = 867 lamps. The foregoing gives the method of calculation in unnecessary detail, for the sake of explanation. The shortest method is: A machine with the primary voltage and amperage 1,040 and 40, has a capacity of 41,600 watts. The capacity of this in 56-watt lamps is evidently 41,600 ÷ 56 = 741 lamps. The size of primary wire to use is found by the formula,

$$\frac{21 \times 1{,}500 \times 40}{\text{volts in ``drop''}}$$

Allowing 5% drop, or 52 volts, the wire is calculated at 24,231 c. m. = No. 6 B. & S. The proper size of wire for secondaries depends on the distance apart of transformers, but probably three No. 6 secondaries would be the best.

"J. M.," Toronto, writes: "I have read with interest your article in the November issue on the transmission to Arthur, Ont. As I, in common with a great many others of your readers, am interested in prospective transmissions, I would take it as a great favor if you would publish a full description of the plant; give length of line, size of wire, number of wires, voltage of transmission; state whether it is single or two phase, number of lights supplied, and the formulae by which the 6% loss was obtained."

ANSWER: The Grand Valley-Arthur transmission plant, referred to by our correspondent, has been in operation for some time. The plant is located at Grand Valley, and consists of a 75 h.p. high speed engine, manufactured by the Goldie-McCulloch Co., of Galt, and an 85 h.p. boiler. Fuel used is mill refuse and slabs. The electrical equipment was furnished throughout by the Royal Electric Co., and consists of a type R "S.K.C." two phase generator, with the the usual station instruments, mounted on a marble switchboard. One phase of the generator supplies incandescent street and house lights for the village of Grand Valley, to the number of about 350, and is distributed in the ordinary way, the primary voltage being 2,080 volts and the secondary 104 volts. The second phase of the machine is carried to the switchboard in the usual way. After passing through the switchboard, it enters a booster transformer, which has a range of 300 volts. This is sufficient to overcome the ohmic loss in the transmission of 9 amperes at 2,400 volts a distance of 13 miles, where it reaches the village of Arthur, and is there distributed in the usual way, 2,080 volts primary and 104 volts secondary. There are also operated at Arthur from this circuit three alternating current arc lamps of a nominal 2,000 candle power, and 15 32 c.p. street lamps, the balance being used up in store and house lighting. The regulation of the lights at Arthur is accomplished from Grand Valley by a regulator head set in the booster transformer, where the primary voltage can be regulated at 20 volts per step, or one volt in the secondary. There is also a telephone line erected on the transmission line, and if the light varies or the voltage raises or drops, the man in charge at Arthur immediately notifies the engineer at Grand Valley. Thus the pressure is kept practically constant. The heart of the entire system is, of course, the transmission line. Special care was taken in the construction of this line. The poles vary from 30 to 35 feet in length, with not smaller than 7 inch tops, set 5 feet in the ground, thoroughly tamped and properly guyed. Running through an open country as this line does, it is subject to severe lightning storms. It was, therefore, very essential that lightning should be guarded against. In constructing the line there was put underneath every fifth pole an iron plate one foot square, No. 16 Birmingham gauge. To this was attached a galvanized iron wire run to the top of the pole and there attached to a barbed wire, which is strung along the entire line on top of the poles, and which is also grounded at each end of the line. This protection has proven sufficient, as it passed through two very severe lightning storms late last fall without any damage. The cross-arms are made of seasoned pine fastened to the pole with two 7 inch lag screws. The pins are of the best white oak, and the insulators triple-petticoat glass. The transmission line consists of two No. 4 bare copper wires, which are fastened to the insulators in the usual way, with a side tie. Beneath this cross-arm is affixed a second one, which carries the telephone wires. The telephone line is constructed in the ordinary way, with the exception that it is transposed every fifth pole, or every 500 feet, to overcome the induction due to alternating current. This it does entirely, as the telephones are in use daily, and conversation can be carried on in an ordinary tone when the transmission line is carrying its full complement of current. That the above is a successful venture is evidenced by the fact that the proprietor of the plant is negotiating for a machine of a larger size, or one having a capacity of 1,000 lights.

The Leamington Electric Light Company, of Leamington, Ont., will increase its capital stock from $3,000 to $30,000.

The Board of Trade of Parry Sound, Ont., has recommended the construction of an electric railway to connect Parry Sound and Depot Harbor. The cost of the road is estimated at $25,000.

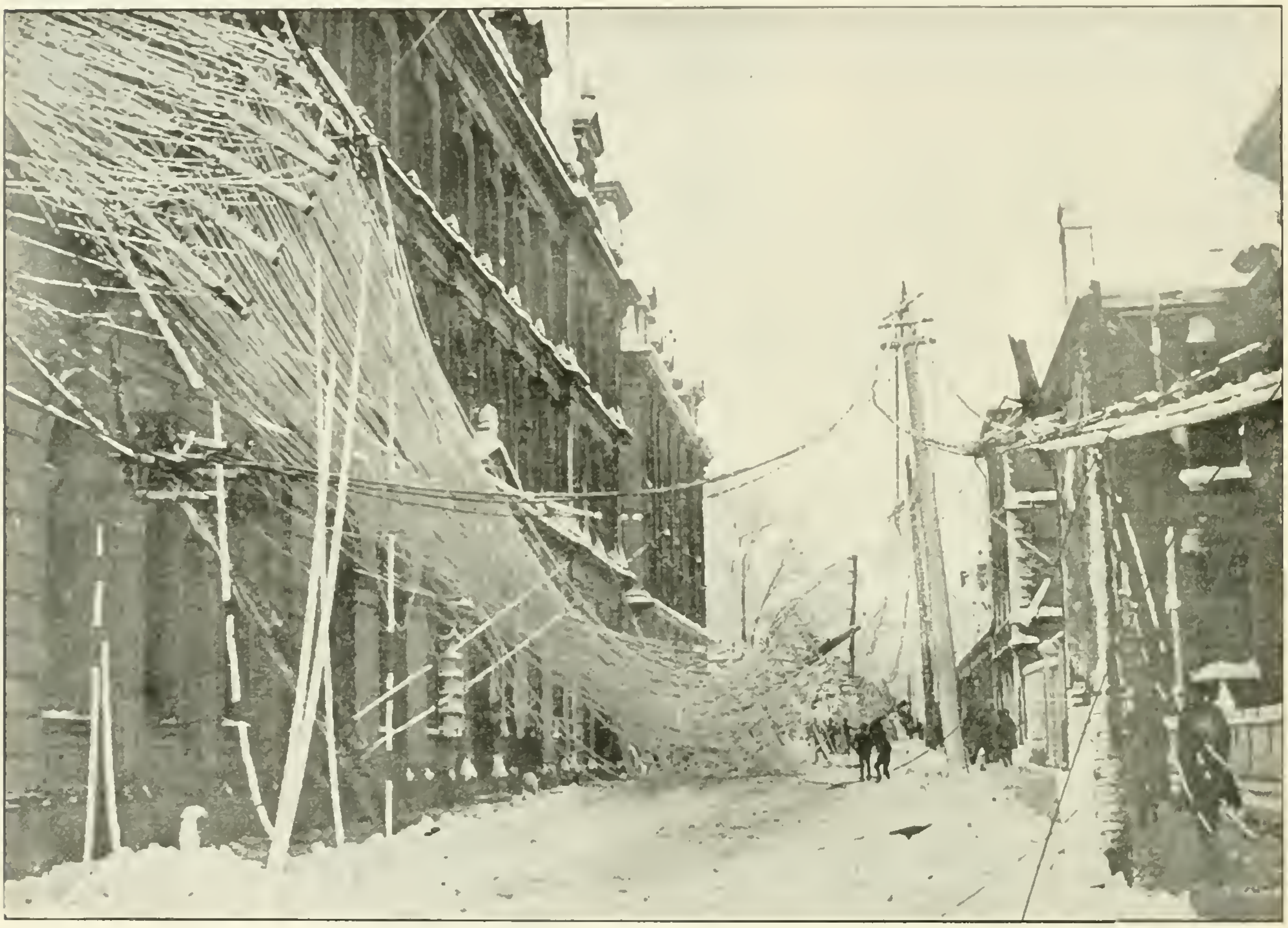
The Gurney Tilden Co., of Hamilton, are now operating their entire works by electric power. They have installed two 20-h.p. and one 30-h.p. S.K.C. two-phase motors, and get their current from the Cataract Power Co.

The gas and electric light works at St. Hyacinthe, Que., were badly damaged by fire on the 5th inst. The buildings, including engines and dynamos, were almost completely destroyed. The loss is estimated at $10,000, which is believed to be fully covered by insurance. The works are owned by Mr. Louis Brousseau.

The Hamilton Electric Light and Power Co. are installing in their lighting station two 240 k.w. S.K.C. synchronous motors. These are to drive the shafting from which is operated the arc machines and the motor power service. The current for these motors is to be supplied by the Cataract Power Co. It is expected that the steam plant will be entirely shut down by the first of February. The incandescent light has been furnished from the Cataract Power Co's current for the past three months, and has been very satisfactory.

EFFECTS OF THE RECENT STORM AT HAMILTON.

After the experience through which they have recently passed, the citizens of Hamilton should be able to appreciate, at something like their true value, the advantages conferred by the modern street railway, electric light, telegraph and telephone systems. The unusually destructive snow and sleet storm which passed over that city in December completely demoralized for a time all these electrical agencies. The accompanying illustration will show even better than a lengthy description the chaotic condition which the electrical companies were called upon to face in Hamilton and throughout the western peninsula. The transmission lines between Hamilton and Niagara and west to Sarnia and Windsor were badly crippled. One of the telegraph officials applied a rule to a No. 8 fallen wire at Burlington and found the diameter, inclusive of the coating of ice, to be 4½ inches, and the weight about 8 lbs. to the foot. It was impossible that even the best constructed lines could withstand such a burden, so that in the sections where the storm raged most severly there was a total collapse. Mr. A. B. Smith, superintendent of construction, and Mr. C. P. Dwight, of the G. N. W. Telegraph Co., Mr. L. B. McFarlane, superintendent of the Bell Telephone Co., and Mr. Homer Pringle, division superintendent of the C.P.R. Telegraph Co., were early on the scene with a large corps of linemen summoned from various directions. As soon as possibie temporary lines of communication were strung, to serve until a permanent restoration of the lines could be effected. This will involve much time and an expenditure running high up into the thousands.



View on Hughson Street, Hamilton, Showing Effect of the Recent Sleet Storm.

ELECTRIC LIGHT AND POWER INSTALLATION.

What is doubtless one of the most complete and conveniently arranged electric plants operated by water power has recently been put in operation at Sherbrooke, Que., by the Sherbrooke Gas & Water Company. The new plant was designed to largely augment their facilities for supplying electric light and power, there being an increasing business in sight, one contract, for example, being the electrical driving of the machinery in the new shops of the Quebec Central Railway in Newington. During last fall their water power was re-developed, the two Leffel vertical wheels being replaced by two 40-inch horizontally set Crocker turbines, and their lighting machines by two 300 k.w. S.K.C. Royal Electric generators, these being belted direct to the water wheel shaft, and the consequent loss by gearing and jack shaft transmission obviated. The company's station, so prettily situated on the rocky little island, has been enlarged and improved. The imposing marble switchboard, the large and nicely finished generators on the main floor, with elbow opening off containing the wheel case and pulleys, within the light and roomy station building, give evidence of the company's determination to be in the front rank in these days of improvement, and reflect great credit on Mr. Sangster, their able and efficient superintendent.

The construction and installation of the water power machinery as a whole was placed in the hands of the Jenckes Machine Co., of Sherebrooke, and the finished work reveals an excellent example of progressive ideas and good workmanship. Two 40-inch Crocker turbines in horizontal setting are contained in one steel case, 10 feet in diameter and over 20 feet in length, and are supplied with water under 31 feet head from the dam some 70 feet away, by two feeder pipes, 80 inches in diameter. Each wheel will develop 518 horse power. The whole wheel case and shafting is supported by steel girders and solid masonry. All bearings are of the self-oiling ring type, and the gate mechanism is operated from a suitable point in the dynamo room overhead. The main driving pulleys located at each end of the wheel case are 108 in. diameter and 36 in. face. The weight of the entire plant is about 125,000 lbs.

Taken altogether, the starting up of this plant marks an important point in Sherbrooke's industrial history, and emphasizes the ability and energy of those concerned.

ELECTRICAL STAGE APPLIANCES.

The proposed application of electrical power for mounting plays at Drury Lane, on the lines advocated by Mr. Edwin O. Sachs, has now taken a tangible form in the completion of the first section of the stage installation in time for the impending pantomime.

Mr. Sachs' present work refers principally to the stage floor and its movability in sections above and below the footlights. The total area now already movable by mechanical power exceeds 1200 square feet.

The electrical appliances just completed take the form of so-called 'bridges,' each working independently. Each individual section measures 40 feet by 7 feet, and weighs about 6 tons, of which about 4 tons are counterbalanced. They can travel about 20 feet vertically.

The motive power is from the ordinary electric supply mains over a four-pole motor, developing 7½ h.p. at 520 revolutions per minute. The 'bridges' are suspended from cables, and these, working over the motor, allow the former to be raised with the necessary live load at rates varying from 6 feet to 20 feet per minute.

Mr. Sachs has arranged for every possible safeguard against accident, the 'bridges' themselves being so constructed that in the event of derangement of current the appliances can be worked by hand gear. Automatic switches are provided so as not to be entirely dependent on the attendants, and automatic catches will work in case of rope-breaking. Special locking gear has been installed to hold the bridges stationary at certain points, such as stage level, and a very large factor of safety has been allowed in apportioning the strengths and weights in the various parts of the mechanism, having special regard to the ever-increasing scenic requirement under Mr. Arthur Collins' able management.

As regards the economic aspect of the electrical installation, the initial outlay on Mr. Sachs' system is about half that of Continental hydraulic work, and this is allowing for English contractors as against foreigners. The maintenance is minimal, whilst the actual working only costs a few pence per performance. The saving in manual labor on the stage is very considerable, whilst the hygiene of the theatre is materially raised by the absence of woodwork.

The Dominion Bridge Company, Montreal, have just completed the installation of an arc lighting system in their large works at Lachine. The dynamo and arc lamps were manufactured by the W. A. Johnson Electric Company, of Toronto.

It is learned that the new electric railway in Kingston, Jamaica, which is being built by Montreal capitalists, is nearing completion. A fortnight ago a trial trip was made, under the direction of Mr. Henry Holgate, superintendent for the West India Electric Co. The speed of the car was about nine miles per hour.

GOOD ADVICE TO BOILER ATTENDANTS.

The Manchester, Eng., Steam Users' Association has issued the following hints to boiler attendants :

Water Level.—Before lighting fires see that there is sufficient water in the boiler. Test the water gauges frequently and keep the water level steady.

Blow-Off Cocks.—Before lighting fires be sure that the blow-off cocks are closed and not leaking. Occasionally feel if the blow-off waste pipes are hot. Blow off from bottom before starting the engine. Sediment has then settled in the elbow pipe. Blow off the scum before stopping the engines, but only when the water level is at the correct height. At such times most of the scum has collected in the troughs.

Lighting Fires.—Sudden changes of temperature may produce fractures or start leakages. Therefore never raise steam hurriedly. The top and bottom of a boiler should grow warm together. If convenient, fill the boiler with warm water through the economizer. If the boiler water is cold, allow fully six hours for raising steam. If pressed for time, fill the boiler to the top of the water gauge, fire slowly, and keep the safety valve open until steam blows off freely. After closing the safety valve, blow out the bottom cold water till the working level is reached. The pressure may now be raised more quickly.

Smoke Prevention.—Smoke and imperfect combustion are caused by an insufficient air supply or by premature cooling of the flames. Therefore after coaling, when the fires are black, admit air either at the door or through the split bridge. It is less wasteful to admit too much air than too little. With smoky boilers or when hard pressed, keep the fires thin and even. Fire steadily. Don't coal all furnaces at once. Coal each furnace on one side at a time.

Emptying Boilers.—Do not empty boiler while steam is up.

Overhauling, Cleaning and Inspection.—Clean the boiler monthly or oftener ; remove the scale while soft, if possible while emptying the boiler. Sweep the soot off the boiler plates and clean the flues every three months, as well as on the occasion of the annual inspection. All leakages should be stopped, any cause of dampness in the setting should be removed, corrosion should be arrested. The fusible plugs should be cleaned on the fire side and water side once a month, and the fusible metal should be renewed once a year at the time of the annual inspection. All cocks should be kept oiled, and, unless asbestos-packed, they should be overhauled once every month. These cocks, the feed valves, steam stop valves, and all safety valves, should be overhauled annually on the occasion of the inspector's visit.

Manholes.—Before opening the man-holes, ease the safety valve so as to be quite sure that there is no pressure in the boiler. Before entering a boiler secure the steam valves and blow off cocks.

Safety Valves and Low Water Alarms.—Never overload or tamper with safety valves or with low water alarms. Ease or test them regularly every day. Be sure that they are in working order. If they will not work properly, reduce the steam pressure and then report to the manager.

Mr. E. O. Champagne, boiler inspector for the city of Montreal, has given public notice that steam users neglecting to provide smoke consuming apparatus will be prosecuted.

MONTREAL.

(Correspondence of The Canadian Electrical News.)

VISIT TO THE CANADIAN GENERAL ELECTRIC COMPANY'S WORKS.

As briefly mentioned in this correspondence last month, a visit of inspection was made on December 2nd, by members of the Faculty, Professor Owen, and the advanced students of the Electrical Department of McGill University, to the works of the Canadian General Electric Company at Peterboro', Ont. The party left Montreal the previous evening in a special car on the C.P.R., the car being side-tracked on its arrival at Peterboro'. The company consisted of Dean Bovey, Professors R. B. Owens (head of the Electrical Department), J. Wallace Walker, R. J. Durley, John Bell, E. Rutherford, H. Jacquays, Mr. F. R. Redpath, and the following students: Messrs. J. A. Shaw, R. E. Burgess, E. P. Featherstonhaugh, E. M. Archibald, L. Denis, L. L. Gisborne, J. C. Hyde, A. T. Grier, R. M. Wilson, H. M. Ewan, John S. Whyte, E. S. Wenger, J. W. Fraser, H. Meredith Percy, F. W. Walker, J. F. Weller, J. E. Glassco, and W. B. McLean.

These gentlemen were met on their arrival by Mr. Stephens, superintendent of the works, Mr. Watts, and other officers of the Canadian General Electric Company, who took them in charge as the guests of the company and extended to them every courtesy and hospitality during their visit.

The greater part of the day was spent in making a close examination of the manufacturing methods employed in the various departments of the works. For this purpose the visitors were divided into four groups, each group being in charge of one of the company's engineers. The meter department was first visited, where opportunity was given of witnessing the construction of the Thomson recording watt meter. Following this came an inspection of the transformer department, where the T. & H. type of transformers was seen in process of manufacture; next the department in which all kinds of fittings, such as sockets, rosettes, small switches, cut-outs, etc., are made. In the brass department the workmen were engaged on the manufacture of switchboards, including a 19-panel board for Winnipeg, designed to handle the complete electrical output of that city, including street railway, lighting and power circuits. There was also to be seen under construction in this department high tension switchboards, including a 4,400-volt board for Napanee.

All the above-mentioned departments are situated in the gallery of the main workshop. Downstairs are the armature department, test department, machine shop, tool room and commutator department. Almost every available foot of space on this floor was taken up with various classes of machinery in process of manufacture, prominent among which was to be seen a 300 k.w. single-phase rotating field alternator for the London Electric Company, a 300 k.w. monocyclic direct connected alternator for Winnipeg, several large synchronous motors for the mining districts, and a number of large induction motors for the Montreal Cotton Company, of Valleyfield, consisting of one 200 k.w., one 150 k.w., four 100 k.w., one 75 k.w. and one 250 k.w. machine; also a 475 k.w. six-pole lighting generator for the Toronto Electric Light Company.

No. 2 building, which was next visited, contains the pattern and carpenter shop, the drying ovens, and in the rear the brass foundry and compound pots for compounding wire.

In the adjoining building is the wire department, where the insulation of various kinds of wire is put on. In the upper part of the building is installed machinery for covering the finer grades of wire and for the manufacture of small armature coils, which are sent to the armature department to be assembled on the bodies. At the rear of the upper part of this building is located the incandescent lamp manufacturing department, which is perhaps the most interesting of all to the student, partly on account of the fact that the process of manufacture has in the past been more carefully guarded than in the case of many other kinds of apparatus, and also because of the many delicate and interesting operations through which the lamp passes in the process of manufacture. This department of the General Electric Company's works is in charge of Mr. Burnett, who took pains to explain as thoroughly as possible to the visitors the numerous details of the manufacturing operations. The work in this department is largely performed by young women, who are residents of the town and have been here trained to the work, which, by the way, requires no small amount of skill. The output of this department is understood to be about 1,500 lamps per day. It was interesting to learn something about the nature of the glass which is so important a material in this branch of manufacture. The visitors were informed that a great many varieties of lead glass had been experimented with, and that so great is the variation in quality that a difference of 50 per cent. in breakage has resulted from the use of different brands. It will thus be seen that the first cost of the material becomes a secondary consideration, as glass which can be purchased at a low price may in the end prove to be the most expensive, owing to its brittleness. The filament, which is so important a feature of the lamp, is in its original form a paste, which is drawn out to the required size and hardens, after which it is vulcanized and covered with a deposit of carbon. This filament is fed through a machine set to gauge, by which it is cut into proper lengths for lamps of various candle powers. The glass bulbs come from Cleveland. Among the more delicate operations connected with the manufacture of the lamps may be mentioned, the fusing of the leading-in wires into glass mounts, the making of the carbon joint between the filament and the leading-in wires, the flanging of the neck of the lamp, the inserting of the mount and filament into the bulb, and the closing up of the neck of the lamp by the fusing together of the bulb and mount. The air is afterwards extracted from the bulb and the lamp sealed up at the bottom. After this operation the lamps go into the testing department, where the vacuum and lighting qualities are tried, each lamp being compared as to its light-giving power with a standard lamp.

The visitors were also shown through the carbon and porcelain works, which occupy a separate building and embrace many interesting processes.

In the evening they were entertained at the residence of Mr. Stephens, and courtesies were likewise extended to them by Mr. Davis, the Mayor of the town.

The following morning they were driven to the Trent Valley Canal, where an inspection was made of the locks and other engineering features of the work, after which they returned to Montreal, not, however, without first having given full expression to their earnest appreciation of the kindness of the Canadian General Electric Company in affording them the opportunity of gaining much valuable information, as well as in looking so well after their comfort during their visit.

A CHARMED LIFE.

During the recent disastrous fire, one of the walls of Greenshield's warehouses toppled over into Craig street, carrying with it a great mass of electric wires and cables, the property of the electric light, telegraph and telephone companies. A day or two afterwards a gang of G.N.W. linemen, among whom was one Pierre Brouillet, were engaged in repairing the damage. Pierre was at the top of a 40-foot pole, when he fell limp across the cross arm, with his hands grasping the iron wires. His companions, with the aid of a couple of firemen, lowered the unconscious man to the ground, and the ambulance hurried him to the hospital, where, much to everybody's surprise, he soon recovered consciousness, and a few hours later walked into the head office of the company and reported for duty. It is not true, as stated in the local papers, that a current of 2,500 volts passed through Pierre's body, as the wire with which he came in contact was not capable of carrying that amount of current. For the same reason it would not be wise to bank on the conclusion that the man who gets in the path of a 2,500-volt current will escape with nothing more serious than a bad shaking up. The victim of this accident has escaped death so many times that he is regarded as the possessor of a charmed life. It is recalled that he fell into the Chambly Canal, but was fished out; that a hoist on which he was standing dropped four storeys without killing him, and that he also escaped death in a fire which destroyed the lives of two of his children.

McGILL UNIVERSITY NEWS.

Professor R. B. Owens has just returned from a trip to New York and Baltimore.

The apparatus for the new equipment of the Electrical Engineering Department is being received and put in place.

Mr. Samuel Insull, president of the Chicago Edison Co., is to lecture at McGill University during the latter part of February.

Dr. A. E. Kennelly, now of Philadelphia, and president of the American Institute of Electrical Engineers, but for a long time engaged in submarine cable work, will give four lectures on Submarine Telegraphy at McGill University about the end of January. All engineers interested are invited to attend.

NOTES.

Winter trolley parties have been introduced over the Montreal Belt Line, to Hotel Bout de l'Isle.

Mr. Normington, late of the G. N. W. Telegraph Co., this city, now with the W.U. Telegraph Co., New York, spent his vacation in Montreal. Mr. Normington was on the U. S. Signal Corps during the late unpleasantness between the United States and Spain, being stationed at Chickamauga Park.

Trade in Montreal during the fall and holiday season has been on the whole good, and there are few, if any, complaints from either the construction or supply houses. The outlook for construction after January, however, is not bright, and the supply men will be correspondingly affected.

It is with pleasure that your correspondent learns of the retention by the Canadian Pacific Railway Co. of Mr. R. A. Ross as their consulting electrical engineer. Mr. Ross is one of the few who can be depended on to act strictly in the interests of his employer and give all contractors equal opportunities in tendering. His previous experience with the General Electric Company and the Royal Electric Company would seem to serve him to good purpose in his present position with the C.P.R.

A certain up-town dry goods store has a very tasty display of table napkins and doylies forming a miniature ice palace, somewhat similar to the genuine palace we had in the good old times. The window dresser, however, can safely offer his thanks to electricity, for without its aid in illuminating the stained glass windows, the effect would be much less attractive. Various other stores display revolving turn-tables, may-poles, etc., in motion, run by motors.

If the miscreant is caught who threw the iron hoop over the transmission wires of the Lachine Rapids Company, thereby making a dead short-circuit and blowing the fuse at the generator, it will be made pretty warm for him. It was evidently the work of some one who knew something more about electricity than the average layman does, but one who, on the other hand, did not pause to think that there might be an employee a few feet in front of said fuse when it blew (as was the case) and who miraculously escaped a bad burn. A fuse blowing on a large generator under a pressure of 4,000 volts is not a pleasant thing to be near, to say the least.

The Eagle Knitting Mills Co., of Hamilton, have installed in their factory a 30 h.p. "S.K.C." two-phase induction motor, which drives their knitting machinery and has replaced their steam plant.

RATE SCHEDULES AND DIVIDENDS.

By "Economy."

Most electrical journals devote a considerable amount of space to papers by well known authorities, dealing principally with the financial side of electric lighting and power service, pointing out how expenses can be diminished and incomes increased. The authors seem to be mostly connected with very large plants, and their proposals and expedients, while theoretically sound, apply only to such large enterprises. Instead of any further trying to cut down the cost of production per k.w. in the generating plant, or of insisting upon a still higher efficiency in all parts of the producing or transmitting system, the electrical fraternity is turning its attention to the establishment of a proper basis for the formulation of rate schedules, having been forced to the conclusion that a uniform rate for all classes of customers, whether by meter or month, is not only unscientific, but actually results in selling electricity to some for less than the cost of production, while other consumers who should be encouraged pay for more than they should. Although the conditions governing the operation of large and small plants are so dissimilar that the adoption of a certain policy may be beneficial for the one, while suicidal for the other, still there are always certain broad, general principles upon which every successful business must be conducted, and which, underlying as they do the business of electric lighting, will apply to some extent to all sizes of plants.

In order that a plant may be a profitable investment, the operating expenses must be as low as possible; the business must be pushed for all it is worth, and losses must be reduced to a minimum. The various expedients for effecting economies in the power house, condensers, heaters, etc., are beyond the scope of this article, and it is assumed that everything has been done in this direction that skill and experience can effect. If without increasing the investment, the business and therefore the income can be increased, the result will evidently be in the nature of a larger dividend. If the total load is not as great as the capacity of the power house, then a vigorous canvass is the first means that would occur to everyone. But in the medium-sized provincial town, which is the condition more particularly investigated in this article, the possible business with the average rates charged has distinctly a clear limit. There is no day business such as is found in cities—in cellars, vaults, restaurants, etc. The business done is principally with stores, hotels, a few private houses, and the churches. A considerable proportion of the population of every medium and small town lives in quite small houses, and is usually considered useless for electric lighting purposes; but if they could be brought in by any means, it might be good business, even if a slightly increased investment were required. Using 10 c.p. lamps generally has a good effect in this direction. But in many cases, a general all-round reduction of rates by a small percentage is counterbalanced by an increase of business, which is of itself advantageous in improving the load and therefore raising the efficiency of operation. A considerable class of possible consumers would no doubt be attracted by proposals based on the shutting off of their lights at 10 o'clock. A 10 c.p. lamp on a 10 o'clock circuit would probably pay the power house a satisfactory sum, while offering great attractions to persons who are not willing to pay a larger rent for a lamp on the chance of wanting it to burn all night—or at odd times during the night. It is a very simple matter to calculate what it actually costs the central station to produce the energy for such a lamp, taking account of all fixed and variable expenses; the possible renting price will be found within the means of very small householders. The probabilities are that in such a case a separate circuit would be required, but only a secondary circuit, and the same transformers might by suitable arrangements be made to cover the increased service.

For stores, alternating long-burning arcs may be used when the space is free from hangings. Where, however, the full capacity of the power house is already rented, the only methods available for increasing business are either to reduce the number of less profitable lamps and cater only to the most profitable business, or to use lamps of the highest efficiency obtainable. Unfortunately, the latter course is possible only at the expense of remodelling the distributing system—as a general rule. For the higher the efficiency of the lamp, the greater necessity for very close regulation of pressure applied. In order to obtain this very close regulation, the entire secondary wiring, including the house work, must be planned with very small allowance for drop, and transformers used of a low "drop" percentage. Whether, under the existing conditions of investment, etc., it is really worth the while of any particular plant to rearrange its distributing system to suit the requirements of more economical lamps, in order to enlarge its income, is a matter for careful consideration. The factors entering into the discussion are: A double benefit results from the use of higher efficiency lamps, first, the reduction of the power required per lamp, and, next, the increased number of lamps that can be supplied by the same power. In a 1,000 light plant the coal saving would probably amount in the course of 12 months to $30 by using 3 watt and 3½ watt lamps. This $30 saving would pay 6% on $500, which would go a long way towards rendering the distributing system fit for such high efficiency lamps. Or if the lines were not remodelled, then the $30 could be devoted to the replacing of such lamps as suffered by the variations in pressure. But the main advantage would be in the fact that more lamps could be supplied by the same machinery. In this sized plants the rental might be increased by at least $50, which would pay a month's wages to the engineer. It is very cheap to sneer at such small savings, but nowadays, with competition from gas and acetylene, and rates being forced down by town councils, dividends must be looked for much more closely and carefully than formerly, and the engineer who does not care to save $50 deserves to lose his place. An engineer who is not above saving $50 in one direction, is very likely to have his wits so sharpened, that he will see another $50 somewhere else.

A thoughtful consideration of the rate schedules of many medium sized plants will reveal many anomalies, and if done in a systematized way by a considerable proportion of the more progressive managers, will probably prepare the way for a more scientific and equitable method, which, after the usual grumbling attending all changes, will give more general satisfaction to both consumers and producers. It is usual to give the same meter rate to all consumers, no matter how large or small their requirements, or what the class of business, whether residential or commercial. Here is an actual case: A prominent politician in a certain town took forty 16 c.p. lamps, in billiard room, large drawing room and other public rooms seldom used, and elsewhere where their use was continuous. His family being small, he really occupied only part of the house, and the whole family always spent about half the year away from home. Paying by meter, of course there was no income from this installation half the year, when the house was shut up. During the other six months the occasions when the house was fully lighted were, as can be expected, few, and the actual consumption of energy was for at least five days a week about what an average 10-light installation should reasonably expect to pay for. This means that the consumer required four per cent. of the total capacity of the plant to be held at his disposal during the entire twelve months, while he paid for the privilege just half as much as another consumer who required only one per cent. of the total capacity. In other words, this extraordinary condition existed that the latter consumer's rate for current was eight times as much as the former's. There are many plants where all wiring is done by the company without charge to the consumer. In such a case, it will be evident that a consumer whose maximum demand bears a large ratio to his average may actually be a source of loss to the power house.

In the above instance, the power house was entitled to expect an amount of business sufficient to pay four per cent. of the entire fixed expenses of the plant, for interest, depreciation, wages, maintenance, insurance, taxes, and also the cost of the coal and water consumed in supplying the amount of energy actually used. The actual payment was, over and above the cost of coal and water consumed, just one-half of one per cent. of all the fixed expenses. The total annual fixed expenses of such a plant that could be fairly charged against the incandescent business amounted to about $2,000. The above installation should have paid four per cent., or $80; it really paid $10. In a limited sized plant, where the demand for light—or the possible demand—is a little beyond the capacity, such an installation is relatively an actual loss. It is an exaggerated case, although an actual one, but every plant that sells by meter will have some similar experience. Many a house is wired for fifteen lights, while the average consumption is reasonable for four. The maximum number burning at any time will be possibly eight or nine. Here, while the consumer should (on the above basis) pay one-eighth of the fixed expenses, he actually pays only one-sixteenth, or half as much as he should. It is true that the difference amounts only to $4, but he is paying the power house for energy $4 less than it costs to produce that energy. This is one good way to avoid being troubled with having dividends. The remedy is simple, and suggests itself at once. A minimum charge should be made to a consumer, proportionate to the size of his installation to cover his proportion of all the fixed expenses of the plant, and then the energy consumed as registered by the meter should be charged in addition. In this way only will each and every consumer pay a fair proportion of the expenses. The way of determining this minimum charge is to establish what are the fixed expenses of the plant, taking into consideration always interest on first cost, depreciation at a percentage, insurance, taxes, and dividing the total by the number of lamps which can be expected. Then each lamp must return at least this calculated minimum, in order that it may pay its way. If it does not, then it simply represents bad business.

It may be objected that to charge this minimum will cause the loss of many customers, and that such method is unnecessary because the results of the whole year's operation are a dividend; that the good and the bad must be taken together; and the policy of management must be judged in the bulk, and not piecemeal. This point is well taken where the business is not sufficient to fill the power-house up to its full capacity: but in many plants it is beyond the present capacity, but hardly enough to justify a considerable increase. In such a case the substitution of a consumer whose average consumption is nearer to his maximum for one whose installation is largely in excess of his usual requirements, is evidently a clear gain to the plant. If instead of the one 60 light customer with his six months' absence and average of 10 lights, five customers could be obtained for eight lights each with an average requirement of four all the year, the result to the plant would be twenty paying lights for twelve months, instead of only ten paying lights for six months. It is very probable that, if a minimum rate be charged for water supply, the business of some consumers would drop off altogether, because it would take some time for people to understand that if they require a certain proportion of the power house to be reserved for their use (and thus render it unavailable for other business) they should pay for the privilege whether they use it or not

Still, it is plain that a thoroughly successful business cannot be built up on erroneous principles, and it does not seem equitable that the small consumers—who really are the best paying ones—should be discriminated against so very heavily as in the above example.

The imposition of a minimum yearly or monthly sum—in proportion to the number of lights installed—to cover all the fixed expenses of the power house, should be offset by taking out that factor in calculating the cost per kilowatt hour. The resultant meter charge per k.w. hr. would be found to be so greatly reduced as to attract many new consumers, to the great advantage of the business.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

NOTE. Secretaries of Associations are requested to forward matter for publication in this Department not later than the 6th of each month.

THE STEAM BOILER AND ITS SAFETY.*

By F. G. MITCHELL, M.E., London.

THE modern demand for high pressure engines is fostering sectional and water-tube boilers. The more rapid adoption of such boilers is retarded on account of so many of their parts being made of cast iron, together with so many joints and connections. These are objected to by the old type manufacturers and those unwilling to accept something new. Nevertheless, the external, horizontal, tubular boiler will soon be out of the modern class as a steam generator. It is limited in the thickness of sheet, and therefore in its diameter. Consequently, on account of its being externally fired, its pressure and power is limited. This alone has turned the attention of boiler manufacturers to a more perfect arrangement for stationary as well as marine purposes.

At the present day the demand is for high pressure in stationary boilers, embracing several designs of water tube and internally fixed boilers of different type. From an economical standpoint there is little difference, notwithstanding the claims and reports of efficient tests advanced by the makers of the different designs. On the other hand, as to the safe working pressure of the boiler, we are compelled to take the maker's figures, as there is no law in this province formulating the proper rules founded on mechanical principles to determine the safe working pressure of the steam boiler.

An instance of the above occurred to me quite recently when called upon to inspect a horizontal, tubular, externally fired boiler. The dimensions of the boiler were 72" diameter and 16' long. The plates were of steel $\frac{3}{8}''$ thick, with a tensile strength of 60,000 lbs. per sq. inch. There were 114 – 3" tubes and the heads were of flange steel $\frac{1}{2}''$ thick. The longitudinal joints were double riveted, the rivets being $\frac{3}{4}''$ in diameter, and the pitch 3", and it is fair to suppose the holes at $\frac{13}{16}''$. The efficiency of the joint so far as net sections of plate are concerned is 3" – 8125 ÷ 3" = 72.9%. The area of a $\frac{13}{16}''$ hole being 0.5185 sq. in., the single shearing strength of one rivet is .5185 × 38,000 = 19,700 lbs. As there are two rivets in a unit section of the joint (the joint being double riveted), the total shearing strength of the rivets in a unit section is 39,400 lbs. The strength of a strip of the solid plate 3" wide being 3 × $\frac{3}{8}$ × 60,000 lbs, is equal to 67,500 lbs. Then, for the efficiency of the joint, so far as the rivet area is concerned, is 39,400 divided by 67.500 = 58.4%. This is much less than the efficiency of the net section, therefore it follows that the joint is badly proportioned. The rivet area is too small; notwithstanding this, the builders had no hesitation in recommending this boiler for a safe working pressure of 100 lbs. per sq. inch, whereas with a factor of safety of 5, the safe working pressure on it is 73 lbs. per sq. inch. The safety valve was set at 100 lbs. per sq. inch, and the owners of this boiler congratulated themselves on their new steel boiler. Really, the boiler was no stronger with the 60,000 lbs. steel than it would have been with 50,000 lbs. iron. Now, a proper double-riveted lap joint for this boiler would be, diameter of rivet $\frac{7}{8}''$, pitch 3 – $\frac{7}{16}''$; efficiency of joint 69.4%. This would give a safe working pressure (with a factor of 5) of 87 lbs. per sq. inch.

Many years ago Sir William Fairbairn stated the efficiency of a single riveted joint to be 56%, and that of a double riveted joint to be 70%. No doubt he meant it to be understood that this was the limit practically obtainable with careful design and construction, and I am sorry to say that it is a common practice among engineers who should know better, to allow 56 and 70 per cent. for single and double riveted joints respectively, without the least regard to the actual proportions of the joint.

Another case which came under my observation not long ago was a horizontal, tubular boiler, externally fired, 48" diam. and 12' long. The plates were of steel, 60,000 lbs. tensile strength, $\frac{5}{16}''$ thick and single riveted. The diameter of the rivets was $\frac{5}{8}$, and the pitch 1 – $\frac{3}{4}''$, and the heads $\frac{3}{8}''$ thick. The workmanship of this boiler was excellent in every respect, and I believe the material was also. The only objectionable point about the boiler was the riveted joint. The diameter of the rivets being $\frac{5}{8}''$, we will suppose the holes to be $\frac{11}{16}''$, or 0.6875. The pitch being 1.75, the efficiency of the joint so far as the net section of the plate is concerned is $\frac{1.75'' - 0.6875}{1.75} - 60.7\%$. The area of a $\frac{11}{16}$ hole being 0.3712 sq. in., the strength of one rivet (assuming the shearing strength of rivet iron were to be 38,000 lbs. per sq. inch) is 3712 × 38,000 = 14,100 lbs., and the strength of a strip of the solid plate 1.75 wide being 1.75 × $\frac{5}{16}''$ × 60,000 = 32,800 lbs. We find that the efficiency of the joint so far as the rivet section is concerned is 14,000 divided by 32,800 = 43%, whereas if properly designed it should be 56%. Now, why is it that an otherwise good boiler manufacturer will allow construction such as this? He might as easily, and without any more expense, have turned out a very much better and safer boiler. It may be possible that the templets used had been arranged for 40,000 or 45,000 lbs. per sq. inch iron. But this does not explain the whole thing, for nowadays the manufacturer will go even a step closer by using only a factor of 4 with practically the same externally fired boiler.

There are many defects that are likely to be found about a steam boiler, and the ones most common are corrosion and grooving along the girth seams, generally on the bottom sheets, and cracks extending from the edge of the sheet to the rivet holes. On the outside landing, this is more often found where heavy plates are used. The most serious form of corrosion is that which attacks the plates along the water level, forming a continuous line of weakness. This is, of course, due to the acids in the feed water, and can only be remedied by improving the supply. External grooving is often due to leaky calking, and is very often caused by the use of what is known as a split calking tool having broken the skin of the metal. Buckled or boged sheets usually result from neglect in keeping the boiler clean. Soft deposits are permitted to accumulate over the fire and become hard, allowing the plates to become overheated and to be pushed down with the pressure. In iron boilers this has been attended by ruptures, while in steel boilers the buckled part grooves thinner at its lowest point until a small hole causes a leak.

I wish to mention, before closing, a very important consideration about the steam boiler, and that is, the so-called mountings. How many boilers do we meet with that have a perfect working safety valve, one that will permit the escape of steam as fast as the boiler will generate it, and not allow the pressure to exceed at most 10 lbs. above what it was set for? Anything else is only an excuse for a safety valve. It is also a common thing to see water columns connected to the boiler with $\frac{1}{2}''$ and $\frac{3}{8}''$ pipe and with 3 and 4 bends in it, and a small pet-cock at the bottom to blow it out? This is another excuse. Also, how often do we see a common plug-cock put on for a bottom blow-off? There are no mountings or fittings too good for a boiler, and none other should be used or allowed to be used.

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* Paper read before the Hamilton Association, C.A.S.E., at December meeting.

WATER POWER ARBITRATION.

IN regard to an item in our last issue in reference to an arbitration between the Laurentide Pulp Co. at Grande Mere, on the St. Maurice river, and the province of Quebec, as to the purchase of some six islands in the river at that point, we desire to state that the great water power at Shawenegan Falls was not in any way connected with the matter in question. That part of the property at this point upon which any considerable water power development must be made is owned by Mr. John Forman, of Montreal, and he expects to be able to utilize it in the near future. Its importance may be surmised from the information given us that it is possible upon this property to create a development of 200,000 to 250,000 horse power, at a cost per horse power not approachable by any water power, so far as is known, upon this continent. For electrical developments, paricularly, this property offers the most extraordinary advantages, and the recent completion and operation of the Great Northern Railway to within a mile and a quarter of the property brings these advantages within commercial reach.

As to the arbitration between the Laurentide Pulp Company and the province of Quebec, we learn that some of the islands were in the water fall of Chute de la Grande Mere, and the others in the river close by, and that the right was asked to partially fill up the bay below the falls, and so create a so-called beach lot. The arbitrators absolutely refused to commit themselves, and inasmuch as the Laurentide Co. now own the whole of the land on each side of the river, as well as all the islands in the river at that point, they can use the whole of the water in the river at that point, if this were possible, without the slightest interference from anyone, so long as they leave water enough in the channel to drive the logs of the lumbermen.

The horizontally set Crocker turbine for the electric light plant at Weedon, Que., has arrived from Sherbrooke, and is being connected to generators,

THE LONDON SPECIFICATIONS.

TORONTO, ONT., Dec. 17th, 1898.

Editor CANADIAN ELECTRICAL NEWS:

DEAR SIR,—Replying to yours of 29th August, I have been out of Toronto since then, but if of any interest at this late date, would comment on the London specifications as follows:

I don't think it right to call for tenders on work that has not been previously sanctioned by the ratepayers; it is simply intended as a menace to the existing company, and is not a proceeding creditable to the London corporation.

The specifications do not interest Canadian manufacturers, as they distinctly call for a Brush machine and an Adams-Bagnall lamp. To specify a particular efficiency is beyond the scope of an engineer's duty. Efficiency is of value merely in relation to price. A high efficiency machine may be held at so high a figure that one of lower actual efficiency and less cost may be the better investment. There is many a good machine made that will not reach 86%; these are all excluded. The amount of belting required is not mentioned, although a detail so important might be expected in a specification that considers it necessary to specify that "armatures shall be electrically and mechanically balanced." I do not believe in any such fancy tests as short-circuiting a machine for five minutes. Its imposition shows that the engineer does not understand the operation of an automatic current regulator.

As to lamps, no engineer has a right to specify any particular apparatus, more especially when, as is abundantly evident in this case, he knows nothing about it. The Adams-Bagnall lamp contains certain patented features, which the London engineer, probably after "expert" investigation, decided would render it superior to any other. And yet his investigation, while convincing him of its superiority, leaves him in the dark as to whether it contains complicated clockwork mechanism or even the usual cut-out device! This is evident, for he states it must not have the one and must have the other. The London engineer's opinion on such a point is evidently of value. Having demanded a particular lamp, can he justly hold a contractor responsible for its "flaming or hissing"?

The rest of the specifications illustrate the general principle that when amateurs go into details they are sure to leave out as much as they put in, and to leave loop-holes everywhere. It is a pure waste of time to specify the dimensions of cross-arms. I should say that the clauses covering everything but machines and lamps represent the result of a careful study on the part of the engineer of the outside work of the London Electric Co. On the whole, the specification appears to be largely composed of sentences copied out of manufacturers' catalogues descriptive of their apparatus, held together by words and conditions representing the knowledge of one who had to measure a cross-arm. It is about the most bare-faced confession of ignorance and partiality that could be decently made, and I do not for one moment believe that it is the work of the London city engineer. It is the result of collaboration between the agents of a manufacturing company and some pushing lineman.

Yours truly,
GEORGE WHITE-FRASER.

LARGE SALE OF RAILWAY APPARATUS.

MR. W. A. Johnson, of the W. A. Johnson Electric Company, reports the recent sale of Westinghouse apparatus to the Metropolitan Railway Company of Toronto, to be used in connection with the extension of the present railway to Lake Simcoe. In the power house at Bond Lake will be installed two 60-cycle, three-phase A.C. D.C. generators, each of about 400 h.p.; and a full complement of switchboard apparatus, step-up transformers, lightning protection, etc., will be provided. The transmission voltage will be 16,500. There will be two rotary transformers, 60 cycles, three-phase, giving 570 volts on direct current side. These will be located at sub-stations about 14 miles from the generating station, step-down static transformers being provided to reduce the voltage to that suitable for the rotaries. The generator switchboard will consist of eight marble panels, the sub-station switchboards of five marble panels, with non-arcing and tank lightning arresters. In addition to the above, there will be passenger and freight car equipments, including one quadruple equipment for heavy freight car and double equipments for two-light freight cars, two double equipments for ordinary passenger cars, and two quadruple equipments for heavy passenger coaches; the motors being used in these will be 38 B. 50 h.p. each. We believe this is the first installation in Canada to use a generator delivering both direct and alternating current from the same machine, as well as the first application of rotary transformers. The sale includes one 45-ton Baldwin-Westinghouse electric locomotive.

AN INCORRECT ADDRESS.

A MISLEADING error occurred in the reference to the new quarters of Messrs. Ness, McLaren & Bate, Montreal, which appeared in our last issue. Their factory, office and show-rooms are located at 419 St. James street, corner of Craig, instead of at the corner of Seigneurs and Craig streets, as given. Persons desirous of purchasing telephones, telegraph instruments, annunciators, switch-boards, fire alarm apparatus and other electrical supplies are requested to note this correction.

WARNING AGAINST ACETYLENE.

THE Rat Portage Miner & Rainy Lake Journal quotes as follows from the Boston Herald: Edward Atkinson, President of the Boston Manufacturers' Mutual Fire Company, in view of recent renewed efforts to introduce calcium carbide and acetylene gas into commercial and manufacturing establishments, has published a cautionary circular in which he says:

"The purpose of this caution is to call upon each and all of our members not to make use either of calcium or acetylene gas without full advisement and consultation at the time the proposed application is to be made. It may happen that the use of these materials may be made safe. At present they are not deemed so. Therefore the introduction of either, without the consent of the underwriters, would make an alteration in the condition of the risk not contemplated in the original contract. It is therefore suggested that no new method of lighting shall be permitted, even for experiment, without consultation."

ENGINEERING NOTES.

A rule by which to estimate the power of a double belt is given as follows: Divide the number of square feet that passes over one of the pulleys in a minute by 40. The result will be the power that it can develop. The authority which gives it says that it does not contain many fine points, but the results are just as reliable as those obtained by more complicated methods. Probably this is true.

OIL FOR BOILER SCALE.—The use of oil as a scale remover in steam boilers is treated in an article in a recent issue of The Locomotive, the conclusions of which are summed up as follows: Mineral oil is often useful for the prevention or removal of scale, when it is properly applied; in the prevailing method of introduction, it gives good results in many cases; but when it has not proved as effective as desired, we recommend that the boiler be dried out and that the kerosene be sprayed upon the plates and tubes. It is important to avoid the use of open lights in or about a boiler that is being so treated; incandescent electric lights are the safest to use. Finally, kerosene is very serviceable for removing lubricating oils from plates and tubes.

ROPE TRANSMISSION.—In a paper on power transmission by ropes and belts, read before the French Society of Civil Engineers, V. Dubreuil states that one great advantage possessed by ropes is that cyclical variations in the speed of the driving pulley are "damped" by the ropes, so that the speed of the driving pulley is much more uniform than that of the driver. Ropes are also useful when the two lines of shafting are not perfectly parallel. The velocity of the rope should not be less than about 4,500 feet per minute, nor more than 5,000 feet, while with belts a velocity of as little as 600 feet per minute may be used, but the maximum should not exceed 4,000 feet per minute, above which the centrifugal force prevents the proper adhesion of the belt to the pulley. For great distances between the lines of shafting ropes should be used; though in exceptional cases they may be employed with as little as 12 feet between shaft centres, in general the distance should not be less than 20 feet. Spans of as much as 328 feet have been worked by ropes with only intermediate support. Under no circumstances should the diameter of the smallest pulley be less than 30 times the diameter of the rope, and in general the pulley ratio should not be greater than four to one. Three standard ropes of manila, hemp or cotton may be used. Hemp is much cheaper than cotton, and usually wears longer, but is less pliable. To facilitate estimates, the approximate weight of a rope pulley may be taken as 5½ pounds per groove for each inch of diameter, though single groove pulleys will weigh double this amount.

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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

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Electrical Students' Competition. IN the announcement which appeared in last issue headed "Canadian Electrical Students' Competition," a typographical error was made. In the subjects of theses, No. 5 should have read, "A Concise Description of a Method of Testing Transformers for Efficiency at Various Loads, both as regards Regulation and Core Loss." Students of electricity who may not have learned of the competition mentioned are referred to our December issue for particulars, and are urged to enter the list of competitors for the prizes offered.

Settlement by Arbitration. THE arbitrators named to adjust the difficulties between the Grand Trunk Railway Company and the telegraph operators employed on the road assumed their duties in Toronto on January 7th. The company is represented by Mr. B. B. Osler, Q. C., the telegraphers by Grand Master Sergeant, while Chief Justice Meredith is acting as the third arbitrator. The two subjects to be adjusted are a minimum rate of wages and the hours of labor, and those interested believe that an early settlement will be arrived at. That this method of reaching an understanding between the representatives of capital and labor has been decided upon, is a tribute to the greater enlightenment of the people in the closing years of the nineteenth century. The day seems near at hand when labor strikes will become relics of the past.

Long Distance Transmission of Power. AN interesting paper on this subject was recently presented before the Society of Arts, London, by Prof. George Forbes, under whose direction the huge enterprise of the Cataract Power Co. at Niagara Falls was planned and put in operation. Prof. Forbes gives it as his opinion that electric power can be transmitted to a distance of 500 miles, using a pressure of 20,000 to 30,000 volts, and that under certain circumstances electric power could be thus transmitted at a profit. He claims that the power of the Victoria Falls on the Zambesi river might in this manner be economically employed in the mines of Rhodesia, and that the city of Cairo could be lighted more cheaply by means of current generated at and transmitted from the First Cataract, 400 miles distant, than by steam engines on the ground.

Street Railway Organization.

OUR attention has recently been called to the necessity of an organization representing the street railway interests of Canada, and we are pleased to learn that in some quarters there is a strong feeling in favor of such a movement It seems that the smaller roads are the most anxious that the formation of an association should be effected. It is pointed out that there are many questions in common affecting the operation of street railways which might with great advantage be dealt with by an association. If taken up independently, the expense and trouble of adjustment is certain to be much greater and the results less satisfactory. The difficulty, in this country, of working successfully an association composed of street railway officials is quite apparent. The limited number of railways necessarily prohibits a large membership, while the great distance from the east to west of the Dominion makes it extremely doubtful that members could be secured in British Columbia, New Brunswick and Nova Scotia. This would confine the membership, in reality, to Ontario and Quebec. The suggestion has been made that there be formed a street railway section of the Canadian Electrical Association. This would be, perhaps, the wiser course to pursue. In the past, we fear the association named has been regarded as non-representative of the street railway branch of the electrical industry, but this has been due to the fact that it received its chief support from the electric lighting, telephone and telegraph interests. Just how to effect an organization that will best serve the interests of the street railway companies cannot be easily defined, but we have referred to the matter in the hope that a discussion may be provoked, and some course of action outlined by those interested.

The Niagara Falls Power Franchise.

THE time granted by the Ontario government to the Canadian Niagara Power Company for the development of a fixed quantity of power on the Canadian side of Niagara Falls expired on November 1st, 1898. The company not having fulfilled its agreement in this respect, the question was submitted to the courts to decide whether or not the franchise should be declared void. The questions which the High Court of Justice was asked to decide were as follows : 1st. Is the agreement void by reason of the failure of the Canadian Niagara Power Company to have 10,000 horse power developed and ready for use by November 1st last? 2nd. May the government declare the agreement forfeited? 3rd. If the agreement cannot be declared wholly at an end, is the government relieved from the agreement not to grant to any other person the right to use the waters of the Niagara river? To each of these questions a negative decision was given, thus permitting the Canadian Niagara Power Company to continue to hold its franchise. That all our readers may understand the situation, we will review, briefly, the circumstances of the case. In April, 1892, the Canadian Niagara Power Company entered into an agreement with the commissioners of Queen Victoria Niagara Falls Park, which agreement was ratified by the Ontario government, whereby the company secured exclusive control of the right to develop power on the Canadian side of the Niagara river, in return for an annual payment of $25,000 for the first ten years, the amount to be increased $1,000 for each year of the second decade until the annual rental shall have reached $35,000, at which figure it might be continued for 80 years. A provision of the agreement was that by November 1st, 1898, the company should have completed water connections for the development of 25,000 horse power, and have actually ready for use and transmission 10,000 horse power. Some time previous to November 1st, the company applied to the park commissioners for an extension of time, but the Ontario government, although hesitatingly, refused to grant the request. Recourse was then taken to the courts to ascertain if the Niagara Power Company still had any legal right to the franchise, with the result given above. The ruling of the court certainly seems ambiguous, inasmuch as it places the owners of the franchise in an almost helpless position. If a violation of the terms of the agreement is not sufficient to annul the contract, the entire agreement is of little value. There are some peculiar features of the case. The company contend that they have supplied the local demand, and that up to the present the problem of long distance transmission has not been satisfactorily solved. Their method of supplying the local demand was by placing two 500 horse power generators in the power house of the Niagara Falls Park and River Railway, situated within the park limits. These are belt driven by the two turbines of the railway company. This 1,000 horse power is almost entirely consumed by the Carborundum Company, the Niagara Falls Electric Light Company, and the Carmelite Monastery. It might be asked what the intention of the government was in granting to a syndicate the right to utilize the Niagara power. Was it not that the development of the power would create a growth of industrial establishments in the vicinity, the supplying of the then existing demand being of minor importance? It is noteworthy that while practically nothing has been done towards utilizing the immense water power of Niagara Falls, the owners of the franchise have permitted the Cataract Power Company of Hamilton to cut off one of their most promising fields for exploitation, namely, the city of Hamilton, while we would not be surprised if, in the near future, the same company would be supplying current to the city of Toronto. This fact, and the apparent indifference and inactivity of the Niagara Company, gives color to the suspicion expressed in some quarters that in securing control of the franchise the Canadian Niagara Power Company had some other motive than that of developing the power. What course will now be taken is a matter of interest. Should the courts not be asked to decide what time shall be given the company for the execution of the work agreed upon?

The National Carbon Company, of Cleveland, Ohio, have sent us a neat calendar, on which is shown a view of their extensive works. It also includes the moonlight schedule for the current year.

The 60 k.w. S.K.C. generator of the Dundas Electric Co. has been placed in position. They expect to have their water-power in operation in a few days, and will begin the lighting of the city by the 15th of January.

TELEGRAPH and TELEPHONE

THE TELEPHONE IN MONTREAL.

The Montreal Telegraph Company, which had control of the Edison patents, and the Dominion Telegraph Company, which originally exploited the Bell telephone patent, both commenced operating telephone exchanges in Montreal in 1878. In 1880 the Bell Telephone Company was organized, and immediately combined these two exchanges into one, at the same time consolidating the whole telephone business of the Dominion under one head. Starting with a capital of $500,000, the progress of the corporation was extremely rapid, until now its capitalization is represented by millions. During its history the company has occupied three different buildings for its main exchange in Montreal. From 1880 to 1885 it tenanted the upper flat of the City and District Savings Bank; the upper flat of the British Empire building was occupied from 1885 to 1897, and in Jubilee year the company moved into its new headquarters on the corner of St. John and Notre Dame streets.

The new building is in every respect a credit to the city. The dimensions are 108 feet on St. John street, 35 feet on Notre Dame street, and 98 feet on Hospital street, six stories in height. On the ground floor are located the local offices of the company, the long distance telephone rooms and waiting rooms. The first and second floors, and a part of the third, are rented as offices, etc. On the third floor is situated the battery room, chief operator's room, offices, etc. On the fourth floor is the company's work-room. The Bell Telephone Company has four other exchanges in Montreal, one at the corner of St. Catherine and St. Andre streets, one at the corner of Mountain and St. Catharine streets, one at 2452 Notre Dame street, and one at Westmount. The switchboards in these exchanges were put in at an aggregate cost of $220,000, that at the main exchange alone costing $120,000.

Mr. C. F. Sise,
President Bell Telephone Company.

The business of the company is growing rapidly. Instead of receiving about 200 calls a day, as in 1880, when the exchange was opened, the average number of calls daily in Montreal is now about 17,000, and 171 young ladies are employed to answer the calls.

Previous to 1892 the Bell Telephone Company manufactured their own appliances and instruments. In that year they were succeeded by the Northern Electric Company, who have a large factory on Aqueduct street. The factory commenced operations with three men, but now employs 250. The building covers a floor area of about 30,500 square feet, and contains under one roof a mechanical department, finishing room, brass foundry, nickel-plating room, buffing room, blacksmith shop, polishing room, wire insulation department, battery department, engine room and carpenter's shop. There are upwards of 250 different machines used in the processes of manufacture.

Mr. C. W. Brown,
Superintendent Northern Electric Company.

Presented herewith are portraits of Mr. C. F. Sise, the organizer and president of the Bell Telephone Company, and Mr. C. W. Brown, superintendent of the Northern Electric Company.

VALUE OF TELEPHONE PLANT.

The appeal of the Bell Telephone Company against an assessment of $638,649 on their plant in Toronto, was argued before Judges McDougall, Dartnell and McGibbon last month. Previously the plant had been assessed at $100,000. This year the assessment was proportioned as follows: Land, $8,750; buildings, $24,000; poles, wires, conduits, etc., $377,992; Temperance street switchboard, $177,174; Yorkville and Parkdale switchboards, $50,773. The decision of the Court of Appeal in the case of the assessment of the Bell Company's plant at Hamilton stood as a precedent. This decision held that the poles, wires, etc., could not be assessed for their value as a part of a growing concern, but only on their value when detached, or as scrap iron.

Mr. Albert L. Salt, assistant manager of the Western Electric Company, New York, was the first witness. He gave his estimate of the value of the switchboards as follows: Temperance street $10,000; Yorkville avenue, $1,900; Parkdale, $565.50.

Mr. Wm. C. Marshall, inspector for the C. P. R. Telegraph Company, said that the wires, poles, etc., of the company were of no value when detached. They would not realize, on sale, the cost of taking them down. The only articles which were of any value were the braces, which, when taken down, would realize about five cents each, half of their original cost. The wire would cost about four dollars a mile to take down, which was more than they would sell for as scrap. Mr. J. J. Wright, manager of the Toronto Electric Light Company, gave similar testimony.

Mr. Edward F. Peck, electric light superintendent at Brooklyn, N.Y., said that, as an outgrowth of his eighteen years' experience, he considered that the Bell poles could be removed, as they stood, for from 25 cents each to $2.50. It was worth $2 to erect a 25-foot pole. There was no market for taken-down galvanized iron wire. The aerial wire, he said, was valuable only as scrap iron.

Mr. Hugh C. Baker, manager of the Bell Telephone Company in Ontario, stated that the company had invested in the Dominion, in realty, $4,171,432.91. This included everything except switchboard instruments and indoor plant. He believed the average life of poles in Toronto to be about six years; they had now lived half their life; the cables, underground, had been used about four years. Cables were worth from five cents to eleven cents per foot; some had been sold at $35 per ton. Wire was worth nine or ten cents a pound when taken down. Poles taken down found little market, and would be worth from 25 cents to $2, according to size.

Expert evidence was also submitted by Messrs. W. Bamfield, of Pittsburg, formerly manager of the Pennsylvania Telephone Company, Jno. C. Reilly, general superintendent of the New York and New Jersey Telephone Company, and others, the case occupying several days. The decision of the court was in favor of the Bell Telephone Company, the assessment being reduced to $102,550, made up as follows: Poles, wires and conduits, $53,900; Temperance street switchboard, $12,000; Yorkville avenue and Parkdale switchboards, $3,900; land and buildings, $32,750.

The court found as follows: "The wooden poles are valued at 25 cents each; the rails and iron poles, considered as "scrap," what the market allows, including cost of removal, etc., are put at $3.50 per ton net; the wire is rated as second-hand and is worth nine cents a pound, while the attachments are valued at seven cents a pound—all considered as scrap."

MR. FREDERIC A. HAMILTON.

Few persons in Canada have had a more extensive experience in sub-marine telegraphy and general cable work than the subject of this sketch, Mr. Frederic A. Hamilton, M.I.E.E., M. Can. Soc. C.E. A brief resume of his services in this connection will no doubt interest many of our readers. He was born at Dover, England, in the year 1843, and after leaving school engaged in the mercantile marine, sailing to India, Australia, New Zealand and the Mediterraneum. He served as a volunteer in the war for Italian Unity under General Garibaldi.

Mr. Hamilton first entered the telegraph field about 1868, studying as a probationer with the Sub-Marine Telegraph Company, one of the oldest companies working between Great Britain and the continent of Europe, until a vacancy offered in the service of the Anglo-Mediterraneum Telegraph Company. He was employed on their Susa-Modica line, at the stations at Naples and Messina, and was appointed manager at Florence, but being desirous of gaining experience in sub-marine telegraphy, resigned and returned to England, and received an appointment in the Telegraph Construction and Maintenance Company as assistant electrician. Whilst in this company's service he was employed in the factories at Greenwich during the manufacture of the Falmouth, Gibraltar and Malta cables, and on the expeditions engaged in laying the Mid-Channel cable, Lisbon-Falmouth, Batavia-Singapore, Singapore-Penang, Penang-Madras, Singapore-Hong-Kong, and Batavia-Singapore sections, both on shore and ship. He was also engaged in removing faults from subterraneum cables.

Mr. Frederic A. Hamilton.

Mr. Hamilton was also identified with the manufacture and laying of the Ireland-Newfoundland cable and the Newfoundland-Cape Breton cables, being on board the ship laying the Sydney-St. Pierre section, and on shore at St. Pierre during the submersion of the St. Pierre-Placenbia section, as well as executing other responsible commissions. He was on board the "Great Eastern" in expedition for repair of the 1865 Atlantic cable in Mid-Atlantic, and was chief electrician on the Cuba cable repairs and in laying shore-end of Brazilian cable at Pernambuco.

In the year 1875 Mr. Hamilton was employed in the traffic manager's department of the Direct United States Cable Company, and in the following year was appointed electrician-in-chief to the Anglo-American Telegraph Company, being sixteen years in this company's service. During the above period he was engaged in numerous undertakings in cable laying and repairing, and in other operations at sea and on shore, in connection with the telegraph system of the North Atlantic. This experience afforded a wide range of knowledge with regard to the various methods of working sub-marine cables, both long and short by Simplex and by Duplex, and especially embracing the important considerations involved in the question of the selection of tracks, a feature closely connected with the study of the principal causes of rupture and injury to sub-marine cables. His services in this capacity were greatly appreciated, and upon several occasions the late Sir John Pender and Mr. Henry Weaver, late managing director of the Anglo-American Telegraph Company, took occasion to commend him upon the ability displayed. Since resigning from the above company in 1892, Mr. Hamilton has been practising as an electrical engineer in Halifax, N.S. He has had considerable experience in the installation of electric light plants both afloat and on shore, and in his private practice has introduced the same degree of thoroughness which was one of the chief factors of his success in telegraph work.

Mr. Hamilton was elected an associate of the Institution of Electrical Engineers in 1873, and was advanced to member in 1886. He is also a member of the Canadian Society of Civil Engineers and the Maritime Electrical Association. It will be remembered that at the convention of the latter society in September last, he presented an interesting paper on "Electric Gong Buoys—Audible vs. Visual Signals." He has also contributed to the Journal of the Institution of Electrical Engineers papers on "Submarine Cables," "Shipping Buoys from Cable Ships," and "Repairs to Submarine Cables," and to the Canadian Magazine an article on "Laying a Sub-Marine Cable."

SHORT-CIRCUITS.

Mr. Fred. Cleveland, formerly of the Great Northwestern Telegraph Company, Montreal, spent a few days in that city at Christmas, visiting his friends.

The Victoria Telephone Company held its annual meeting at Beaverton, Ont., last month, at which it was decided to extend the system to Pefferlaw, Beaverton and Bolsover.

The Department of Public Works at Ottawa has invited tenders for the construction of a telegraph line from Alberni to Cape Veale, in British Columbia, a distance of 38 miles.

Mr. R. B. McMicking, manager of the Victoria and Esquimault Telephone Company, Victoria, B.C., was recently presented by his employees with a pretty cane, ornamented with silver bands and tips, and suitably engraved.

Mr. William H. Hayes, assistant manager of the Bell Telephone Company at London, Ont., has been transferred to Windsor, where he will assume the position of local manager. Mr. Hayes is to be congratulated upon his promotion.

It is said that four Ottawa barristers will seek incorporation at the next session of the Dominion parliament as the Royal Telegraph Company, with a capital of $1,000,000. It is proposed to construct and operate telegraph and telephone lines throughout the Dominion.

The Merchants' Telephone Company, of Montreal, was organized in 1893 by Messrs. A. S. Moisan and J. M. Marcotte, now president and secretary respectfully of the company. The exchange was opened on January 1st, 1895, with 472 subscribers. Since that time the number has increased to 1,800, twenty-two operators being employed.

Mr. Charles R. Hosmer, manager of the C. P. R. Telegraph Company, returned to Montreal a fortnight ago after a six weeks, visit to London and Paris. Shortly after his arrival home he received a cablegram announcing the dangerous illness of his daughter, whom he had left in Paris to complete her education, and was compelled to return again to Paris.

While repairing the wires of the Great Northwestern Telegraph Company, in Montreal, after the recent sleet storm, Pierre Brouillet, who had ascended a pole on Craig street, in company with two other linemen, came in contact with a live wire. The Montreal Gazette states that, although he received a shock of upwards of 2,500 volts, the only visible signs are two slight black lines on each hand.

REPORT AS TO ELECTRIC LIGHTING IN PEMBROKE.

BELOW will be found a copy of the advisory report of Mr. Roderick J. Parke, E.E., submitted to the municipal council of Pembroke, Ont., regarding electric lighting. Mr. Parke was retained by the Council to assist them in overcoming a difficulty with the Pembroke Electric Light Company, and in that connection to furnish estimates of the cost of a municipal plant. The report is a particularly interesting one, and although taking a neutral standpoint, is none the less valuable :

In formulating this report, advising you as herein, I assume a strictly neutral standpoint between the two principals concerned, namely, the citizens or corporation of Pembroke, represented by your honorable body, and the Pembroke Electric Light Company, controlling the supply of electrical illumination in Pembroke. This position I take upon my own responsibility, as in taking it I can the better assist and advise you toward the attainment of the most desirable results in dealing with the company, while at the same time respecting its lawful rights, as you desire to do. It is not my intention to interfere with the rights or operations of the company, beyond that degree affecting the just and legal rights of the corporation of Pembroke. This point I desire to draw particularly to your attention, as on this basis alone is this report submitted, and on the same basis must all negotiations be conducted or actions taken by yourselves or by any other duly authorized representative of the corporation, whether negotiating with the company regarding an extension or continuation of its contract, or whether concerning the purchase and installation of a corporation plant.

The estimates herewith submitted show, firstly, the cost of purchasing and installing an electrical plant as part of the water-works plant now owned by the town, this electrical plant to be capable of supplying both street and private illumination services of sufficient extent to meet the probable requirements of the town, with provision for an increase in capacity should such be made necessary through a considerable increase in population ; and, secondly, the approximate cost per annum of thirty arc street lamps of 2,000 nominal candle power each, the approximate cost per lamp per annum of 16-candle-power incandescent lamps for house and store illumination, both services operated in conjunction with the water-works system, and finally, the approximate charges necessary to be asked for private illumination service in order that the revenue therefrom may be sufficient to provide free street lighting and at the same time cover all expenditure in connection with the incandescent system. Your attention is respectfully called to the fact that the estimate of cost of installing the street lighting plant includes an ultimate capacity for fifty lamps of 2,000 nominal candle power, and further provides for the adoption of a much more economical type of lamp than the one now in use on the streets of many towns and cities, and one capable of furnishing a much more satisfactory, better diffused, and steadier illumination than can be furnished by the older type.

Your attention is further called to the fact that the estimate of operating expenses and approximate necessary revenues is based on the operation of the electrical plant as part of the water-works system, which necessarily places the municipal electrical plant at a considerable advantage over that of the company, owing to the possibility of eliminating and dividing certain expenses among the street, private incandescent, and water-works systems.

Where no industrial system or service has already been established in a municipality, and that municipality desires to undertake to supply itself with any or all of these services, the question of control or ownership, private or public, can of course be more easily dealt with, but in the case of Pembroke, where we find that a private plant has already been installed and is now in operation as any other commercial enterprise, controlled by, and therefore involving more or less, private capital, justice demands that the owners thereof shall receive due consideration, such consideration, however, to be secondary to that due the majority of tax-paying citizens as a whole.

While the estimates given show approximately, and within as close a degree of accuracy as can be, what the town can do for itself in the event of installing and operating a municipal plant, it must be borne in mind that the same plant or system under private control cannot reasonably be expected to supply illumination for the same relative cost to the taxpayer, on account of requiring a larger staff of employees, hence heavier operating expenses, and, having as well to fulfill the intention for which the system is created, namely, payment of dividend on the capital invested therein. In view of the fact, therefore, that vested interests demand fair consideration and an opportunity for self-protection in your town, the following advice is respectfully offered, in the full belief that your hearty co-operation in it will be assured so long as there is a reasonable chance of the interests of the citizens as a whole being properly protected :—

I would advise : Firstly, that the Pembroke Electric Light Co. be asked to confer with your honorable body at some mutually convenient time, with a view towards eddeavoring to come to an understanding along the lines concerning the rates for incandescent lighting for private consumers, as described under Estimates of Operating Expenses, sec. (c), Combination Services, sec. (d), Rates and Revenues ; and, further, with a view toward arriving at some definite annual charges for street lighting, at so much per given candle power of lamp per annum, both street and private rates to be compatible with the payment of a reasonable dividend, (specific), on that amount of capital actually necessary to install the same capacity in a municipal plant, together with the bona fide operating expenses of a municipal system having therein the highest efficiencies obtainable in electrical, steam, water-power, transmission and translating devices, such as generators, engines and boilers, water-wheels (if water-power be adopted), distribution lines, transformers, and arc lamps. In connection with the subject of bona fide expenses, I would advise your insisting, with all due deference to the company, that all books, office records, vouchers, etc., in relation with the actual operation of the system be constantly accessible to the duly authorized representatives of the corporation. Secondly, that the company be required to enter into an agreement in proper form, with the corporation, concerning the basis on which future charges shall be calculated as the demand for lighting increases throughout the town, during the term of the agreement or contract.

I would further advise that the corporation guarantee the company a full and absolute protection from other competition, municipal or private, during its faithful compliance with the terms and conditions of the agreement, this protection to be guaranteed through the contract covering a period of not less than five years, nor more than ten years.

In order that the circumstances surrounding the respective positions of the corporation and the company may be the more readily understood and appreciated by yourselves, the company, and the citizens, the following considerations must be allowed their full value in each case :

(1). Any municipality has an equal right with the private purchaser or consumer to obtain the supply of any commodity or article having a commercial value, from that source which can or will supply such article at highest attainable quality and lowest cost to the purchaser.

(2). A municipality, having the right and power to not only purchase its industrial services and supplies from the most reliable, convenient, efficient and economical sources, but to undertake to supply itself with such services under municipal ownership and control, thereby affording to its citizens, under proper management, a service at lower cost than that afforded by the privately owned system, would most certainly be unlikely to knowingly choose the more expensive source of supply. Therefore, if it grant protection to a private enterprise, allowing it to exist as a monopoly within the limits of the municipality, it has every legal right to insist on being supplied with a service as efficiently and as economically as can possibly be obtained through any other private source or system operating under similar circumstances or comparative conditions. The private enterprise accordingly owes its existence in a very large measure to the good will of a majority in the municipality. If the private company will not supply the best services obtainable under the existing conditions, or under remedied conditions, and at the lowest consistent cost to the consumers compatible with a fair return on the capital invested, then the municipality can with justice take such action toward bettering the conditions as it may deem advisable, whether by cancelling all rights and privileges accorded the company and granting a franchise to any other company or body capable of and willing to undertake such supply, or by entering into the manufacture and sale of the service on its own account.

The corporation of Pembroke has, therefore, a legal right to deal as may seem best with the Pembroke Electric Lighting Company in the interests of the citizens as a whole. If the company will not enter into a fair, just and equitable contract with the corporation, after being allowed every opportunity for so doing at the hands of your honorable body, it should be evident to every fair-minded citizen of Pembroke that you can only proceed to discharge your duty to those for whose interests you are acting by arranging for the purchase and installation of a municipal lighting system. As I have already advised, it will be more in the interests of justice to all concerned to endeavor as far as possible to deal with the company, at the same time showing your willingness to grant favorable terms and conditions in return for equally good faith on the part of the company. If the company, after due negotiations, will not enter into a fair agreement with the corporation—an agreement which can be proven by a disinterested authority to be practicable to both sides—the choice as to the next action to be taken in the matter of obtaining a better and more efficient lighting system will have to remain for yourselves to decide.

INSALLATION COSTS.

1. Street Lighting Service (Capacity, 50 Arc Lamps, 2,000 c.p., of improved type):

(Estimate calculated without regard to any other electrical plant, such as private lighting, etc.)

Arc Generator, capable of supplying fifty 2,000 c.p. lamps..	$2,000
Arc Lamps, suitable for street service (30 installed)	900
Arc Distribution Wiring, including cost of placing on poles	1,950
Poles installed for entire arc circuits, @ $3 each set......	960
Steam Engine—high speed—to be installed in W.W. station	800
Boiler Plant—present boilers can be used to advantage.	
Foundations, for generator and engine, including addition to present waterworks station....................	2,100
Belting, including other accessories to steam plant........	130
Incidental expenses, including engineering supervision...	1,200
Approximate total cost of plant installed complete..	$9,140

2. Private Lighting Service (Capacity, 2,500 16 c.p. lamps).

(This estimate calculated without regard to any other electrical plant, such as street lighting system, etc.)

Alternator, capacity 2,000 to 2,500 lamps, installed.......	$4,000
Transformers, sufficient for the first two years' supply....	1,000
Incandescent Lighting Distribution, including poles set...	8,800
Steam Plant, slow-speed engines, condensing, highest quality, including countershafting and belting, installed	6,500
Foundations and Lighting Station Building, ext'n to W.W.	4,000
Incidental expenses, including engineering supervision...	1,687
Approximate total cost for separate incand'nt plant,	$25,987

3. Combined Installations:

By combining the street and private lighting plants under one roof and management, the costs of installing can be materially reduced. Under the same combination the costs of operating can be very considerably reduced.

Arc and Incandescent Plants installed as one whole system, all in complete running order and comprised of materials of the highest obtainable quality and durability, and machinery of highest efficiencies, including addition or extension to permit waterworks pump-house to accommodate electrical plant, can be purchased and installed at a cost not exceeding	$30,000

OPERATING EXPENSES.

(a). Street Arc Lighting (2,000 c.p. lamps):

This estimate is calculated on the basis of the streets being illuminated by fifty arc lamps of 2,000 nominal candle power each, from dark of moon until daylight, every night in the year, and including cloudy nights which would otherwise come under the moonlight schedule. The estimate is further based on the adoption of the latest, most approved, and most economically operating and proportionately small expense for trimming and attendance, the plant to be operated in conjunction with the waterworks system.

Interest, on cost of plant, 5% per annum...	$457
Depreciation, on cost of plant, 5% per annum............	457
Carbons and Trimming, Attendance, etc......	500
Fuel (wood at $1.50 per cord, delivered)...............	900
Contingencies (oil, waste, repairs), ample allowance, annual	600
	$2,994
Total cost per annum for 50 lamps of 2,000 candle power,	$2,994.00
Annual cost per 2,000 candle power lamp............	59.88

(b) Private Incandescent Lighting (2,000 16 c.p. lamps):

This estimate is calculated on the basis of a very probable demand during the first years of operation, of not less than 2,000 lamps of 16 candle power each. Also, that the plant be operated in conjunction with the waterworks system, but without regard to street lighting. Highest qualities and efficiencies of apparatus used throughout.

Interest, on cost of plant, 5% per annum..............	$1,499.35
Depreciation, on cost of plant, 5% per annum.........	1,499.35
Fuel (wood at $1.50 per cord, delivered)	1,350.00
Labor and Attendance (2 men, at $600 and $360)......	960.00
Contingencies (oil, waste, repairs), annual allowance ..	600.00
	$5,908.70
Total annual cost for 2,000 lamps of 16 c.p.......... .	$5,908.70
" " one lamp "	2.96

(c). Combined Public and Private Services:

This estimate is based on the operation of the street and incandescent lighting plants as one system, in conjunction with the waterworks plant, under the one staff of employees, sufficient for all practical purposes. Owing to larger steam units required for the combination plant, the consumption of fuel can be very materially reduced through the adoption of engines and steam generating plant of higher efficiencies. The interest on the combined costs will also be below that of the total cost of two separate plants.

Interest on combined cost, $30,000 @ 5% per annum......	$1,500
Depreciation on combined cost, $30,000 @ 5% per annum	1,500
Carbons for arc lighting plant, @ $35 per M.	160
Fuel for two plants—compound condensing engines......	1,600
Wages—2 men. Lamp trimmer dispensable on account of enclosed type arc lamp, requiring trimming 4 times per month. Assistant can easily attend to lamps. Wages at rate of $600 and $360 per annum.........	960
Contingencies, under combined operation, annual........	900
	$6,620
Total cost per annum, 2 plants under combined operation,	$6,620

(d). Rates to Consumers and Approximate Revenues.

The following schedule shows approximately the charges necessary to be exacted for private incandescent lighting in order to cover operating expenses of that system, and at the same time afford free street lighting to the corporation:

	Per Lamp per Annum.
Average rate with 2,000 incandescent lamps in use....	$3.30
" " 2,500 " " "	2.80
" " 3,000 " " "	2.40

The above rates are approximate, but correct within 10 per cent.

As the operating expenses do not increase in direct proportion to the number of lamps in use, the greater the number of lamps used in the one plant the lower the price per lamp until that point of demand is reached whereby an increase in capacity of plant and number of attendants is required. Hence the rates to users of incandescent lamps can be proportionately reduced so that the service can be placed within reach of every citizen, and yet the revenue therefrom will always be amply sufficient to afford free street lighting besides covering the private lighting operating expenses. It is on these lines that the negotiations with the Pembroke Electric Light Company should be conducted, particularly with a view toward securing for the majority of the citizens who cannot afford to use the private lighting service at the present rates, a price so that all can ultimately obtain some practical personal benefit from the system which they are now protecting through the medium of the company's franchise.

MOONLIGHT SCHEDULE FOR JANUARY.

Day of Month	Light.		Extinguish.		No. of Hours.
		H.M.		H.M.	H.M.
1....	P.M.	5.10	P.M.	10.30	5.20
2....	"	5.10	"	11.30	6.20
3....	"	5.10	A.M.	12.30	7.20
4....	"	5.10	"	1.30	8.20
5....	"	5.10	"	2.40	9.30
6....	"	5.10	"	3.50	10.40
7....	"	5.10	"	4.50	11.40
8....	"	5.20	"	6.00	12.40
9....	"	5.20	"	6.20	13.00
10....	"	5.20	"	6.20	13.00
11....	"	5.20	"	6.20	13.00
12....	"	5.20	"	6.20	13.00
13....	"	6.30	"	6.20	11.50
14....	"	7.40	"	6.20	10.40
15....	"	8.50	"	6.20	9.30
16....	"	10.00	"	6.20	8.20
17 ...	"	11.00	"	6.20	7.20
18....	"	11.10	"	6.20	7.10
19....	"	.....	"	6.20	6.10
20....	A.M.	12.10	"	.....	
21....	"	1.20	"	6.20	5.00
22....	"	2.20	"	6.20	4.00
23....	"	3.20	"	6.20	3.00
24....	No Light.		No Light.		.....
25....	No Light.		No Light.		.....
26....	No Light.		No Light.		.....
27....	No Light.		No Light.		.....
28....	P.M.	5.40	P.M.	8.20	2.40
29....	"	5.40	"	9.20	3.40
30....	"	5.40	"	10.20	4.40
31....	"	5.40	"	11.20	5.40
			Total.........		213.30

SPARKS.

Mr. C. E. Nailor, of Essex, Ont., intends putting in a new incandescent electric light plant in his flour mill.

Mr. W. T. Douglas has resigned his position as manager for the Bell Telephone Company at Stratford, Ont.

The business men of Baldur, Man., are considering the advisability of constructing a telephone system for the town.

At Prescott, Ont., the by-law to raise $15,000 for a municipal electric light plant was carried by a majoriy of 37 votes.

The village of Forest, Ont., defeated two by-laws, at the municipal election, providing for the establishment of a municipal electric light plant.

The citizens of Ottawa, Ont., have declared in favor of a Sunday street car service. The result of the vote was 4,628 for and 1,664 against.

It is announced that the Richelieu & Ontario Navigation Co. purpose placing an electric light plant and boiler in the steamer "Saguenay" this winter.

The ratepayers of St. Thomas, Ont., have voted down the by-law to provide funds for the installation of an electric light plant, to be operated under civic control.

It is said that representatives of the Toronto Railway Co. were recently in Whitby in connection with a proposal to extend the system to that town and Oshawa.

A by-law to authorize the city council of Winnipeg, Man., to install a municipal electric light plant, at a cost of $50,000, was voted down by the ratepayers last month.

The efforts of certain citizens of Nelson, B. C., to have the electric light by-law declared invalid have been defeated. The Electric Light Co. will, therefore, get $35,000 for their plant.

Mr. Thomas A. Low has secured an option on the water power of the late M. L. Russell, at Renfrew, Ont. It is said that the town may purchase the power and establish an electric light plant.

Municipal control does not seem to have been a success in the town of Richmond, Que., as we observe that the corporation is offering for sale their dam, water-wheels, dynamos, machinery, etc.

The John R. Scott Co., of Napanee, Ont., are increasing their plant by putting in another "New American" water wheel, which will give them 500 horse power. The company intend to extend their line to Arthur and Colebrook next spring.

Messrs. Daly & Hamilton, of Rossland, B.C., are asking for the incorporation of the British Columbia Electrical Supply Co., Limited, to supply electric light, heat and power, and construct railways, telegraph and telephone systems, and other works.

The W. A. Johnson Electric Company are installing an alternating plant for the corporation of Acton, Ont., including 55 street lamps and all wiring for the town. The generator will be one of their inductor type alternators, which are meeting with much success.

At the next session of the Ontario legislature a company will seek incorporation as the Haliburton, Whitney and Mattawa Railway Company, with power to build a steam or electric railway from a point on the G. T. R. at Haliburton to Whitney and Mattawa.

Letters patent of incorporation have been granted to the Metropolitan Electric Co. of Ottawa, with a capital of $500,000. This company, as mentioned previously, are developing a waterpower at Britannia, and purpose supplying light and power throughout the city of Ottawa.

The Grand River Electrical Power Co. has been organized by Messrs C. H. Carroll, J. F. Boltbee and A. N. Parney, of Paris, and W. J. Clark and Thomas McLaughlin, of Toronto. The capital is $90,000, and the company have power to supply electric light, steam, heat, and natural gas.

The directors of the Hamilton, Chedoke & Ancaster Railway will apply to parliament for an amended charter, giving them power to build a line to Brantford, to change the name to the Hamilton, Ancaster & Brantford Electric Railway Co., and to increase the capital stock from $100,000 to $200,000.

A son of Mr. William Williams, manager of the Gas & Electric Light Co., Sarnia, Ont., had a narrow escape from suffocation by gas recently. He had descended into a trench to examine a break in the main when he was overcome by the fumes of the gas. Fortunately, his condition was observed by his fellow workmen.

Mr. R. Weddell, who owns a controlling interest in the Trenton waterworks, is at present negotiating for an amalgamation of the electric light and waterworks companies there, with a view to increasing the power plant so as to operate both and supply power to manufacturers. It is also proposed to light the city of Belleville, 12 miles distant.

The electric light plant at Granby, Que., is now partly in operation, and will soon be entirely completed. A pair of 30 inch Crocker wheels are being untilized at present, plenty of water being available, while the 250 h.p. Corliss engine is being set up. The whole plant is modern, and the arrangements reflect credit on the Jenckes Machine Company, contractors for the plant equipment.

The Alliston Electric Light Company, of Alliston, Ont., are making changes in their lighting station, and have decided to increase their incandescent lighting capacity. For this purpose they have placed their order with the Royal Electric Company for one of their 60 k.w. "S.K.C." two phase machines, from which they will serve both arc and incandescent lights as well as power, which has heretofore been served by both machines.

A syndicate, at the head of which is Mr. George Skead, the original discoverer of Lake Girard mica mine, is engaged in opening up a new mining district on the Big Blanche river, near Thurso, Que. The syndicate have secured several thousand acres of mining land in that vicinity, and are now taking out about five tons of culled mica per week. Associated with Mr. Skead are Messrs E. A. Blakeney and H. K. Lee, of Ottawa.

Mr. Alex. Pushle, an engineer of the Dominion Coal Co., of Cape Breton, has gone to South Africa, where he will superintend the experiment of using the patent fuel manufactured in Cape Breton on locomotives and for general steam purposes. About two months ago 250 tons of this coal were shipped to South Africa by the Dominion Coal Co. If found satisfactory, an extensive field will be opened up for the waste product of the coal mines of Cape Breton.

The Jenison by-law was carried by the ratepayers of Port Arthur, Ont., on the 2nd inst. By this the town agrees to pay Mr. E. S. Jenison the sum of $10,000 per annum for 40 years for 750 electric horse power and 250,000,000 gallons of water per year. The scheme, already familiar to our readers, involves the construction of a canal from Kakabeka Falls to Port Arthur. This canal, it is said, will develop 20,000 horse power, and have a head of water at Port Arthur of 300 feet.

The Canadian, British Columbia & Dawson City Telegraph Company, Limited, has been formed, with a capital of $1,500,000, to construct a telephone system to the mining districts of the Yukon river. The directors of the company are: Sir James Grant, K.C.M.G., Ottawa; Sir Adolphe Caron, K.C.M.G., M.P., Ottawa; J. H. Turner, M.L.A., ex-premier British Columbia; Ald. John Hyde, of Banbury; W. H. J. Fawcus, director Edison & Swan United Electric Light Co., Limited, Dartmouth House. W. Young, 64 Victoria street, London, is the secretary.

According to the London Electrical Review, one of the most novel systems of electric canal towage that has yet been tried is meeting with such great success that the line is to be extended some fifty miles. Small track tricycles, equipped with six horse power motors, run along a French tow-path, taking their current from an overhead wire. These are sufficiently powerful to draw a 300 ton boat at a speed of 1.5 miles an hour. While the system is not cheaper than animal haulage, yet the speed is greater and the service very regular. There are two generating plants, each of 200 horse-power, one at each end of the line.

Tenders for the proposed electrical power transmission plant at Orillia, Ont., were opened by the council a fortnight ago. For the electrical machinery three tenders were submitted, from the Canadian General Electric Company, Toronto, Royal Electric Company, Montreal, and Westinghouse Electric & Manufacturing Company of Pittsburg, Pa., through the Central Construction Company of Buffalo, N. Y. For the transmission line supply and construction, tenders were submitted by the Canadian General Electric Company, Central Construction Company, and C. H. Patriarche, contracting electrical engineer, Toronto. Three tenders were also submitted for the hydraulic machinery and construction, from William Kennedy & Sons, of Owen Sound, Ont., Central Construction Company, and P. H. Patriarche. No decision has been reached as yet, but it is believed that the council favor the tenders of P. H. Patriarche, for the whole equipment, including electrical apparatus of the Royal Electric Company's manufacture, at $66,680, and the Central Construction Company, of Buffalo, including Westinghouse electrical apparatus, at $67,200.

SPARKS.

Some of the residents of Thessalon, Ont., are in favor of taking steps to introduce the electric light.

The capital stock of the Imperial Oil Co., Petrolea, Ont., has been increased from $500,000 to $1,000,000.

A project is on foot to build an electric railway between Trenton and Westville, N.S., via New Glasgow and Stellarton.

The merchants of Souris, P.E.I., are considering the advisability of having the town lighted by electricity. Oil lamps are now used.

Mr. J. M. Clark is a farmer just outside the town of Smith's Falls, Ont., who has just had his buildings wired for electric light.

The town of Barrie, Ont., has entered into an agreement to take over the plant of the Barrie Electric Light Co., at the price of $22,501.

Mr. Thomas Chater, chief engineer for the Windsor Electric Light Co., Windsor, Ont., was caught by a shaft and slightly injured recently.

The by-law to raise $5,000 for the extension of the electric light plant at Thorold, Ont., was defeated by the ratepayers at the municipal elections.

The first narrow gauge railway train operated by electricity in Europe was given a trial on a short road between Dusseldorf and Kerfeld, Germany.

The C.P.R. steamship fleet will receive a general overhauling at Owen Sound, Ont., during this winter. An electric light plant will be installed on the "Alberta."

The Wallaceburg Electric Light Co., of Wallaceburg, Ont., has been granted an extension of time to February 1st, for the installation of an incandescent lighting plant.

At a meeting of the directors of the St. Catharines Electric Light Co., held on December 30th, it was decided to add to the plant a new engine and boiler, at a cost of $6,000.

The Lake Megantic Pulp Company, of Lake Megantic, Que., will ask the government for an increase of its powers, with a view to supplying electric light and power and constructing tramways.

The first annual dinner of the employees of the Winnipeg Street Railway was held in Winnipeg on January 2nd. In order that most of the employees might attend, the dinner was held at midnight.

The electric light plant at Stanbridge East, Que., will be in operation in a few days. The feeder pipe for water wheel is now being laid in, and the Crocker turbine, furnished by the Jenckes Machine Company, of Sherbrooke, Que., has arrived.

Tenders for the electric wiring for the new city hall at St. Thomas, Ont., were received as follows: Rogers & Co., London, $395; H. L. Gray, Toronto, $409; Matthew Stearns & Son, St. Thomas, $568. The tender of H. L. Gray was accepted.

It is reported that the widow of the late John W. Keeley has entrusted to a former Canadian, in the person of Mr. T. Burton Kinread, late of Moncton, N. B., the task of completing and perfecting the Keeley motor. Mr. Kinread is now located in Boston, Mass.

Mr. Charles MacBeth has established business in the Masonic Temple building, London, Ont., under the name of the Ontario Electric Company. The new firm will keep in stock a supply of electrical apparatus, and will give special attention to electric wiring.

The electric lighting plant recently sold to the corporation of the town of Campbellton was started up for Christmas lighting. The driving power is water, and the electrical apparatus is of the Royal Electric Company's "S.K.C." two phase type, for arc and incandescent lighting and power.

The Niagara Falls Park & River Railway Co. have brought action against the town of Niagara Falls, Ont., to recover the sum of $124.42, paid as taxes by them to the corporation on a $6,000 assessment on their roadway. The company claim that the property is a public highway, and therefore exempt.

The Chicago Record states that the Count de Jotemps, of Jaris, France, has closed a contract with the Fischer Equipment Co., of Chicago, under which the latter agrees to furnish 500 horseless vehicles each year for the next ten years. It is also said that the count has closed other contracts for 1,500 vehicles.

The General Electric Co., of Schenectady, N.Y., has received an order from the company which is constructing the underground street railway in Paris, for eight electric locomotives and necessary equipment. The locomotives will be of the same type as those or the Central London Underground Railway. The length the Paris road is three miles.

The Gendron Manufacturing Company, of Toronto, recently decided to install a direct-connected 600 light generator for lighting their factory. The order was placed with the W. A. Johnson Electric Company for a generator and the wiring of factory. They will use a 10 × 10 Ideal engine, manufactured by the Goldie & McCulloch Company, of Galt, Ont.

The corporation of Beeton, Ont., recently decided to install an electric light plant. It was put in about two months ago, and since then the number of lights has increased to nearly the capacity of their present machine, which is one of the W. A. Johnson Electric Company's inductor type of alternator, suitable for a plant where a repair shop is not near by.

The council of the town of Dartmouth, N. S., will ask power from the provincial legislature to issue $150,000 of bonds for the purpose of operating a street railway in Dartmouth and vicinity. A bill will also be submitted empowering the issuing of bonds to the amount of $50,000 to establish an electric light plant for lighting the streets and public buildings.

The Wallaceburg Electric Light Company, of Wallaceburg, Ont., have been supplying arc lights for the town of Wallaceburg for a number of years. Now they have decided to go into the incandescent lighting business, and have placed their order with the Royal Electric Company for a 30 k.w. alternator and 900 light capacity in "S.K.C." transformers and material.

A rumor has been current that the street railway at Sherbrooke, Que., had been purchased by Messrs. Frank Thompson & Co., financial agents of that city. This company is said to have secured the Brompton Falls water power, and to have decided to proceed at once to extend the line to North Hatley and other points. The report, however, has not yet been confirmed.

The ratepayers of the city of Hull, Que., carried a by-law on January 2nd to raise $8,000 for the installation of an electric light plant for street and city lighting. The plant will incude two 50-light dynamos, seventy-five 1,200 c.p. arc lamps, and some eight miles of line. Tenders for same will be invited and the work proceeded with at once. The city owns a suitable water power, which will be utilized for the purpose.

At the ensuing session of parliament, Mr. George E. Kidd, of Ottawa, acting for a syndicate, will apply for a charter incorporating a company to construct a steam or electric railway from the city of Ottawa to Meach's Lake, with branches to Graham's Bay, Aylmer and Hull. Should a charter be granted, the work of construction will be commenced in the spring. The capital stock of the company is placed at $500,000.

Mr. Percy Domville, of Hamilton, Ont., has presented to the city council of St. Thomas, his report on the cost of installing a civic lighting plant. His estimates for 100 arc-light plant are as follows: Steam plant, $7,550; electric plant, $13,571.50; buildings, $9,300; duplication of plants, $8,000. For installing in connection therewith an incandescent plant of 3,000 lights the cost is given as follows: Steam plant, $9,550; electric plant, $18,225.

There is an arrangement between the Dominion government and the street railway companies operating in most of the large cities in Canada, by which the letter-carriers use the street cars in the performance of their duties. For this consideration the Montreal Street Railway Co. have been paid the sum of $200 per month, but the Postmaster-General was notified some time ago that the service would not be continued upon this basis. The company claim that a record of the work performed shows that at regular fares the sum to be charged would be over $1,000 per month, and hence their refusal to renew the contract on the former terms. In Toronto the price paid is said to be $400 per month.

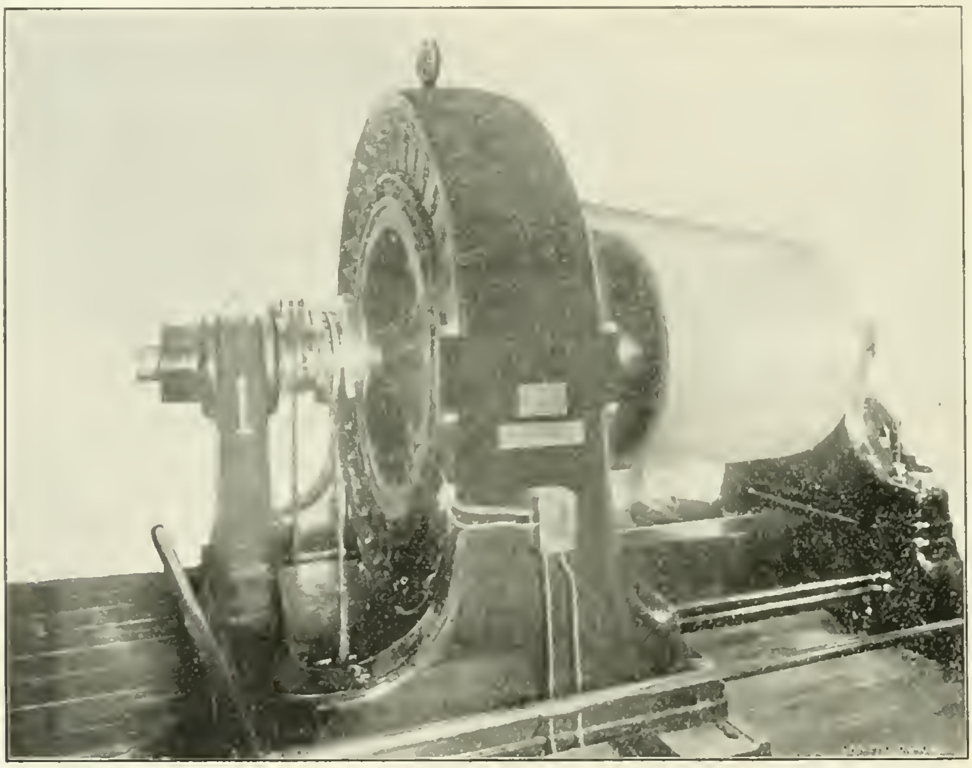
In the December number of the Street Railway Journal, of New York, appears an article by Mr. William Banks, of the Toronto Railway Co., dealing with the methods of increasing street railway traffic. After referring to the necessity of creating traffic by establishing parks and other places of amusement, Mr. Banks says: "This city has an extensive water front and a beautiful island summer resort within the city limits, and it is anticipated that at no distant date boat trolleys will be placed in operation along the water front by our company to carry passengers to and from and around the island." Mr. Banks describes methods of co-operating with steam railways and boats to handle excursion parties and people arriving to attend anusual entertainments.

LARGE ELECTRIC LIGHT DYNAMO.

The illustration on this page represents what is claimed to be the largest dynamo which has yet been installed in Canada for electric lighting service. It is one of the latest type of Westinghouse alternators, and was installed in the power house of the Ottawa Electric Company by Messrs. Ahearn & Soper, of Ottawa, Canadian agents for the Westinghouse Electric & Manufacturing Company.

The voltage is 1,200; alternations, 16,000; speed, 445 r.p.m.; capacity, 420 k.w.; weight (alternator and exciter together), 33,500 lbs. A particularly noticeable feature of the machine is its low temperature. It was guaranteed to deliver 420 k.w. continuously at a temperature rise not exceeding 40° C. The test made by the Ottawa Electric Co. gave 488½ k.w. on a ten-hour run, with a temperature rise of only 11° C.

The field poles of Westinghouse alternators are built up of thin sheets of steel and then placed in the mould, and so cast into the cast iron yoke or field frame. In this way the field poles are constructed of the best possible material, an extremely powerful magnetic field being secured, while the losses due to eddy currents, which are sometimes very serious where solid field poles are used, are eliminated by the use of the laminated poles. The armature is absolutely iron clad, and can be readily handled without danger of damage to the winding. The construction is such as to facilitate insulation against high potentials, while in case of accident coils may be removed and replaced without difficulty.



Large Electric Light Dynamo.

COMPARATIVE COSTS AND PROFITS OF CABLE, ELECTRIC AND HORSE CAR OPERATION.

Some interesting figures are published in the Street Railway Journal showing a comparison of the relative cost of operation of the cable, electric, and horse-car systems of the Metropolitan Street Railway Company of New York. The data was obtained from the private cost sheets and other records of the company, and covers a period of twelve months, ending June 30, 1898. The experience of the Metropolitan Company points unmistakably to the great superiority of electricity over both horses and cable, not only in traffic handling capacity, but in economy.

The relative traffic densities measured by the receipts per mile of track and per car mile as shown in one-quarter's report are as follows: Cable, $39,000 per mile of track and $.333 per car mile; electric, $17,000 per mile of track and $.260 per car mile; horse, $8,000 per mile of track and $.288 per car mile. The average earning power of the entire system was about $14,000 per mile of track and $.29 per car mile. These figures are for one-quarter only.

It is shown that 11% of the company's entire mileage which is operated by the cable system is earning 28% of the total passenger receipts; the 28% which is operated by the electric system is earning 32% of the total passenger receipts, and the 61% which is operated by horses is earning but 30% of the total passenger receipts. For the year, the operating expenses of the cable line were 16.424 cents per car mile, of the horse lines 17.87 cents, and of the electric lines 10.23 cents. The electric lines during the twelve months earned 16.67 cents net per car mile, or but 1.25 cents less than the cable system, in spite of the fact that the latter has 7.434 cents per car mile greater receipts.

From a careful study of the figures, it is believed that were all the lines in New York city to be equipped with a single motive power, electricity would have a permanent advantage over the cable of at least 3.05 cents per car-mile in maintenance of way, a slight disadvantage in maintenance of equipment, and an advantage of at least 1.25 cents in power, of 1.5 cents in transportation, and of .5 cent in general expenses—a total of nearly 6.75 cents per car mile. In comparison with horse traction, electricity would be at a disadvantage of perhaps .5 cent per car mile in maintenance of way and .5 cent in maintenance of equipment; while it would have an advantage of at least 6 cents in motive power, 1.5 cents in transportation and 5 cents in general expenses—a net difference of 7 cents. Besides this, electric cars would earn more than either horse or cable cars with equivalent mileage.

In the transportation expenses it was found that electric traction is the cheapest of the three motive powers, the reason for this being in the greater speeds of cars possible with electric traction. In every division of operating expenses electricity has a decided advantage over the cable system, and in every division except maintenance of equipment it has an advantage over the horse system. During the twelve months' period the cable lines operated at 47.7 per cent. of their passenger receipts, the electric lines at 37.9 per cent., the horse lines at 65.3 per cent., and the entire system at 53.3 per cent.

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OFFICERS OF THE MONTREAL STREET RAILWAY COMPANY.

It is with much pleasure that we present to our readers the accompanying group of portraits of the officers of the Montreal Street Railway Company.

HON. L. J. FORGET. MR. JAS. ROSS, C.E.
MR. D. A. L. MCDONALD. MR. F. L. WANKLYN, C.E. MR. W. G. ROSS.
MR. MARTIN H. WATTS.

OFFICERS OF THE MONTREAL STREET RAILWAY COMPANY.

Hon. L. J. Forget, the president of the company, is a native of Terrebonne, and a Senator for the division of Sorel. In addition to occupying the presidency of the Montreal Street Railway Company, Mr. Forget is president of the Richelieu and Ontario Navigation Company, a director of the Royal Victoria Insurance Company and of the Montreal Trust and Deposit Company, and vice-president of the Board of Governors of Laval University, Montreal.

Mr. F. L. Wanklyn, C. E., the manager and chief engineer, was born in Buenos Ayres in 1859, and educated in England. In Canada one of his first appointments was as assistant mechanical superintendent of the

Grand Trunk Railway, and later manager and master mechanic at the Point St. Charles locomotive works. Besides discharging the duties of these positions, he acted as consulting mechanical engineer to the Montreal Street Railway during the construction of the power house. He was appointed general manager of the Toronto Street Railway Company in January, 1897, resigning in the fall of the same year to assume the position he now fills. He is a member of the Canadian Society of Civil Engineers and an associate member of the Institute of Civil Engineers, England.

Mr. James Ross, C.E., vice-president and managing director, was born in Scotland, coming to Canada in the seventies. Since then he has been identified with the construction and management of various well-known steam railroads, his most notable work in that direction being the construction of the line of the Canadian Pacific Railway across a considerable portion of the prairies and through the Rocky mountains and the Selkirks into British Columbia. Since 1892 Mr. Ross has directed his attention and energies chiefly to street railways, and the cities of Montreal, Toronto, Winnipeg and St. John owe the successful construction and operation of their street railway systems largely to Mr. Ross' directive ability. In 1896, in conjunction with Mr. William McKenzie, of Toronto, Mr. Ross acquired the tramways systems of Birmingham, England, with the object of converting the system to electricity, and in 1897, in conjunction with the same gentleman and others, secured a charter and franchise from the Government of Jamaica to build electric tramways on the island. Mr. Ross is vice-president of the Toronto Railway Company, president of the Winnipeg Electric Railway Company, and of the St. John Railway Company, and president of the Dominion Bridge Company.

The comptroller of the company, Mr. W. G. Ross, was born in Montreal in 1863, and was appointed to the position in 1896. Previous to this he was engaged in the reorganization of the accounting departments of the Montreal, Toronto, Winnipeg and St. John Street Railways, which all have a uniform system of accounts. Mr. Ross is a prominent member of the Street Railway Accountants' Association of America, and one of the organizers of the same.

Mr. Martin H. Watts, the secretary of the company, is a native of London, Eng., where he was born in 1861. He came to Canada toward the end of 1886, and in December of that year entered the service of the Canadian Pacific Railway, where he was employed for four years in the law department of the company. In April, 1893, he secured the appointment of private secretary to Mr. Henry A. Everett, the well-known street railway promoter of Cleveland, Ohio, and at that time vice-president and managing director of the Montreal Street Railway Company. He filled this position, and subsequently that of secretary to Mr. Granville C. Cuningham, late manager and chief engineer of the company, until June, 1896, when, upon the death of Mr. Edward Lusher, Mr. Watts was appointed secretary.

Mr. Duncan A. L. McDonald, the superintendent of the Montreal Street Railway Company, was born at St. Thomas, Que., in June, 1859, and removed to Montreal in 1875. He entered the service of the Montreal Street Railway in 1881 as a "knight of the whip," in order to acquire a thorough knowledge of street railway work from its very commencement. He was soon advanced to conductor, and after about twelve months' service in that capacity, was promoted to the position of roadmaster. In 1886 he severed his connection with the company, but anticipating the progress that the trolley system would make, he went to St. Paul and Minneapolis in 1889 and secured a practical knowledge of the operation of electric tramways. He returned to Montreal in 1892 and re-entered the service of the Montreal Street Railway in the capacity of inspector. He was appointed to the position he now occupies in 1894.

QUESTIONS AND ANSWERS.

"J. M.," Toronto, writes as follows regarding the Arthur transmission plant: "Your article in January number, regarding above, for which I have to thank you, has been carefully read. On figuring out the line on the basis of the figures which you give, namely, that it delivers to the primaries of the step down transformers, over 13 miles of No. 4 wire, 9 amperes at 2,080 volts, I find that the loss in line only is 15½ %. To get the total transmission loss, you must add to the above the losses in the transformers and in the secondary wiring, which will bring the total to something over 19%, instead of its being less than 5%, which your November article states it to be. If I am mistaken in above, I should be glad to be corrected. If my figures are correct, the publication in your February issue of an article correcting the November article will be much appreciated."

Answer.—In answer to the above, we believe the calculations given are correct, but the article in the November issue did not state the number of amperes transmitted at that time, which, for our correspondent's satisfaction, we may state was only five amperes, and at the pressure then in use, the ohmic loss was less than five per cent. In our reply in January, we perhaps should have noted that the loss was more than five per cent., owing to the transmission of nine amperes of current instead of five, for which the line was originally laid out. The business in Arthur has grown to such an extent that the owner of the plant has found it necessary to purchase a 1,500 light machine, and to operate at 4,000 instead of 2,000 volts, which will leave the losses, owing to the increased voltage, very small again.

"H.W." asks: (1) Will common iron wire serve as lightning arrestors when strung on electric poles from top to bottom, with the lower end connected with water? Will lightning jump from the electric wire to the ground wire or iron wire when placed an inch or two apart? (2) Is there any probability of acetylene gas or lime-light taking the place of electric light? (3) Is the system of using 220 to 240 volt lamps likely to come into general use? Do the underwriters accept these lamps?

Answer. (1) If ordinary fence wire is placed as described, with a few inches projecting above the top of the pole, and the lower end buried, it will be of great assistance as a lightning guard to the machinery, especially if lower end reaches water. Such wires should be placed quite frequently, say every fifth pole. Do not, however, take out the station arrestors. An inch gap is a rather long distance for the lightning to strike across, especially if there be any "grounds" on the system. (2) It is not wise to prophesy, but in the writers' opinion acetylene or lime-light will never displace electricity. Advantages claimed for acetylene over electricity are brighter light for less money. At the present, the best incandescent lamp is not very efficient, using only about five per cent. of the energy it dissipates. Scientists are experimenting all the time, with a great probability that in the near future incandescent lamps will have an efficiency of double what they have now. That means either same light for half the money, or double the light for the same cost. Anyone who prefers the rather ghastly light of acetylene to the clear, cheerful glow of electric lamps is entitled to his preference, but he must take the risk of unpleasant smells, and quite possible explosions. (3) Underwriters accept 220 and 240 volt lamps in Europe and the United States when special precautions against leaks, etc., are taken. The only reason why such voltage is not more generally used is that the lamps are rather less efficient than those of lower voltage; and there seems to be some little doubt of the manufacturers being able to produce a really good and durable lamp. No doubt, however, both these points will before long be satisfactorily settled.

"INDUCTION" writes: (1) What would be the resistance and line loss on a two-phase system carrying a load of 40 amperes (17 amperes and 23 amperes on each phase) at a pressure of 2,000 volts? The station voltmeter connected to a transformer of 20 to 1 ratio requires to register 118 volts to overcome loss, resistance and induction. The distance from power house to center of distribution is 25,300 feet, and the wires used are No. 3 B. & S. (2) How can I color incandescent lamps for decorative purposes that they may be cleaned at any time? (3)' What does each division on an S.K.C. static ground detector denote when connected to a 2,000 volt primary?

ANSWER.—(1) The resistance of 25,300 feet of No. 3 circuit under the described conditions with 23 amperes is 97.3 ohms. As, however, the circuit contains joints, etc., it will be somewhat higher. The loss on such a circuit carrying 23 amperes (for copper resistance) will be 238 volts. The "inductive" drop will somewhat increase this loss, but unless some other data are given, such as distance apart of wires, it is not possible to accurately calculate it. The dynamo voltage, to overcome the above resistance, and leave 104 volts at the lamps, should be 2,318 volts—the indication on a 20–1 volt meter should be 116. No doubt the other two volts are required for joints, etc. (2) A very weak solution of shellac with the color added can be cleaned off by alcohol. (3) This information can best be furnished by the Royal Electric Company.

ELECTRIC LIGHT INSPECTION IN CANADA.

The report of the Commissioner of Inland Revenue for the Dominion, for the year ending June 30th, 1898, gives particulars regarding the inspection of electric light. The total revenue derived therefrom was $9,472, made up as follows: Fees for inspection, $5,388.25; registration of companies, $3,970; penalties, $114. The expenses of inspection were $3,236, and there were expended on standard instruments, $3,768.80, leaving a net revenue of $2,467.35. There were inspected during the year 3,754 meters. Of these 3,496 were found correct, 141 fast, 48 slow, and 10 unsound. A number were accepted after first rejection.

PERSONAL.

Mr. S. W. Jenckes, of the Jenckes Machine Company, has been elected a member of the town council of Sherbrooke, Que.

Mr. W. P. Cooke, of Port Arthur, was, at the municipal elections in January, elected as Railway and Light Commissioner for the town. He was also chosen as a councillor.

Mr. John C. Gardner, formerly secretary and manager of the Canadian Manufacturer Publishing Co., Limited, has been appointed president and managing director of the Might Directory Co., of Toronto, Limited, vice Mr. J. M. Might, retired. No doubt the energy and success which marked Mr. Gardner's career in his former capacity will be bronght to bear upon the duties of his new position.

Many Canadian friends of Mr. F. C. Armstrong, who in May last accepted a responsible position in connection with the electrical department of Dick, Kerr & Company, of London, England, were pleased to have the opportunity within the past month of again meeting him. The purpose of his visit, however, was matrimonial in character. On January 12th he took as a life partner one of Cobourg's society favorites, in the person of Miss Helen McCallum. Before their departure for England, Mr. and Mrs. Armstrong visited some of the principal cities in the United States.

MOONLIGHT SCHEDULE FOR FEBRUARY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 5.50	A.M. 12.20	6.30
2....	" 5.50	" 1.00	7.10
3....	" 5.50	" 1.30	7.40
4....	" 5.50	" 2.40	8.50
5....	" 5.50	" 3.40	9.50
6....	" 5.50	" 4.50	11.00
7....	" 5.50	" 5.50	12.00
8....	" 5.50	" 6.00	12.10
9....	" 5.50	" 6.00	12.10
10....	" 6.00	" 6.00	12.00
11....	" 6.00	" 6.00	12.00
12....	" 6.30	" 6.00	11.30
13....	" 7.30	" 6.00	10.30
14....	" 9.00	" 6.00	9.00
15....	" 10.30	" 6.00	7.30
16....	" 11.10	" 5.50	6.40
17 ...	"	" 5.50	5.40
18....	A.M. 12.10	"	
19....	" 1.10	" 5.50	4.40
20....	" 2.00	" 5.50	3.50
21....	" 2.40	" 5.50	3.10
22....	No Light.	No Light.	.....
23....	No Light.	No Light.	.....
24....	No Light.	No Light.	.....
25....	No Light.	No Light.	.....
26....	P.M. 6.20	P.M. 9.00	2.40
27....	" 6.20	" 9.20	3.00
28....	" 6.20	" 10.20	4.00
......	....	....	.....
......	....	....	.....
......	....	....	.....
		Total.........	183.30

Mr. J. R. Rayden, master mechanic at the Trail smelter, was killed by a shock received while repairing the switchboard in connection with the electric plant.

The town of Goderich, Ont., will seek authority from the provincial legislature to raise $5,000 for the purpose of improving he electric light and waterworks plants.

The Laurention Water and Power Company, of Lachute, Que., have requested extensive powers from the provincial legislature. The company propose to operate in the northern counties of Quebec, supplying electric light, gas, heat, power, etc., and constructing telephone lines. Mayor Prefontaine, of Montreal, and Mr. Pierre Laforest, of Joliette, are interested in the company.

The Canadian Marine Engineers' Association, Toronto, have elected officers for the ensuing year as follows: Hon. president, O. P. St. John; president, Harry Parker; first vice-president, A. J. Woodward; second vice-president, D. F. Campbell; secretary, S. A. Mills; treasurer, H. Brownley; inside guard, H. Bowler; auditors, D. L. Foley, E. J. O'Dell, Owen Sound; council, Thos. Good, Wm. Harwood, Rees Bench, Toronto; P. J. Carr, Port Dalhousie, and J. E. Kane, Kingston.

CANADIAN ASSOCIATION OF STATIONERY ENGINEERS.

NOTE. Secretaries of Associations are requested to forward matter for publication in this Department not later than the th of each month.

VALVE-SETTING.*

By W. Sweet.

THE paper which I present to-night is upon valve-setting of steam engines, which is known to engineers throughout the world as a most essential feature. My paper is divided into three parts, namely, dead centre, valve-setting, and the relative position of the valve to the piston at all points of the stroke. I make this division for the purpose of treating each one separately. First I will take up dead centre. Nearly every engineer has a way of his own for finding the dead centre of an engine. The method which I have adopted is no doubt familiar to the most of you. The first thing to be done is to take a piece of wire and sharpen one end, and bend the wire almost in the shape of a figure 3; slip this piece of wire over the guide bar, so that it is comparatively firm, and let the sharp point project as close to the crosshead as possible. Then place the crosshead about one inch from the end of the stroke; now make a mark with a scriber on the crosshead, and move the wire so that the point is directly opposite the mark. Next take another piece of wire and sharpen both ends of it; then bend one end so that it projects at angles. Go to the fly-wheel or disc, make a mark on the floor, let the long end of the wire rest in the mark on the floor, and the projecting point come in contact with the wheel, and scribe a mark with it. Now turn the engine on the centre so that the mark on the crosshead comes directly opposite the point of the wire, go back to the fly-wheel again, and scribe another mark with the trammel in the same position as before. If this is done correctly, the centre between these two marks (which can be correctly obtained by the use of the compass) brought to the point of the trammel will be the dead centre of the engine.

Now we proceed to set the valve. This is a point which should receive very careful attention. Make sure that the valve has the correct travel; after this has been ascertained, proceed to give the valve the proper amount of lead, which depends upon the speed of the engine. The greater the speed the more lead is required. I might state that there are three kinds of leads; proper lead, improper lead, and permanent lead. I might also state that permanent lead can only exist in four-valve engines, but is most likely to be given to the valve of Brown engines, as these engines have their valve spindles screwed into the dash pot pistons; and engineers that are not thoroughly practical men, and not knowing what the results would be, are very apt to screw the dash pot piston down instead of moving the eccentric or cam ahead on the cam shaft. By screwing the piston down on the spindle to get the proper lead will give permanent lead. The position that the valve occupies to the piston may be determined in various ways, but the most accurate way, in my opinion, is to remove the steam chest cover, then place a piece of paper between the valve and face of the ports, attach a string to a reducing motion attached to the cross-head, the same as would be used for an indicator, pass the string around the pulleys, and bring it down past the centre of the steam chest; to the string attach a lead pencil, then by turning the engine over by hand and holding the pencil so that it will move up and down by the motion of the string from the crosshead, and using the face or the edge of the valve as a guide, an oval will be traced on the paper by the pencil, and by laying off the ports on the oval on the opposite side, according to the travel of the pencil, using a scale of one, two, or three inches of the crosshead travels to one of the pencil, this will give the position that the valve is to the piston at any part of the stroke.

Mr John Philip, of Grand Valley, is supplying the town of Grand Valley and the town of Arthur, which is thirteen miles distant, with incandescent light from his incandescent lighting plant in Grand Valley. He has met with such success with his transmission plant that he has purchased from The Royal Electric Company a 75 k.w. S.K.C. two-phase alternator, which he is installing in his power station. This will enable him to deliver at least 1,000 lights wired up in Arthur, and also to serve everything in sight in Grand Valley. As heretofore noted, this is a new departure in electric lighting, and we are glad to hear of Mr. Philip's success. It shows what pluck and enterprise will do.

CANADIAN ELECTRICAL STUDENTS' COMPETITION.

The publishers of the CANADIAN ELECTRICAL NEWS hereby offer a first and second prize of $15 and $10 respectively for the best thesis submitted by an undergraduate of a Canadian university on any one of the following subjects, viz.:

1. "The Magnetic Circuit of Dynamos."
2. "The Incandescent Electric Lamp."
3. "The Electric Meter."
4. "The Relative Advantages of Low and High Frequency in an Alternating Electric Lighting Plant."
5. "A Concise Description of a Method of Testing Transformers for Efficiency at Various Loads, both as Regards Regulation and Core Loss."
6. "Comparison between Two and Three Phase Installations for the Long Distance Transmission of Power."

It is required that each thesis submitted in this competition shall consist of not less than 5,000 nor more than 6,000 words, and shall be written in the third person, and typewritten for publication on one side only of foolscap paper.

To admit of a fair comparison of the merits of the theses which may be submitted, keeping in view variety of subjects, a system of marks will be employed such as is generally used in college examinations, and with which the competitors in this competition are familiar. These marks will be allotted under three heads, viz.:

1. Subject Matter.
2. Arrangement.
3. English.

Taking 100 as the combined total, the maximum and minimum marks for each of the above classifications will be as follows:

Maximum.		Minimum.
50	Subject Matter	25
25	Arrangement	15
25	English	15

If any of the theses submiited should not be entitled to receive the minimum of marks as above, they will be entirely rejected.

There are three sources from which competitors must draw their subject matter, viz., books, periodicals and floating literature, personal or private channels. In judging of the subject matter, the following relative values will be attached to the above mentioned sources of information:

(a) Books	10
(b) Periodicals and floating literature	20
(c) Personal or private sources	20
	50

Where extracts are used, their source and names of authors should be clearly given.

Where diagrams are required to illustrate the text, they should be drawn with pen and perfectly black ink on pure white drawing paper, bristol board or tracing linen, and in such manner as to admit of their reproduction to a small scale.

Each thesis shall be submitted by motto only, and shall be accompanied by the name of the author enclosed in a sealed envelope bearing the same motto. This envelope will remain sealed in the hands of the publishers until the competition shall have been decided.

Theses submitted in this competition must reach the C. H. Mortimer Publishing Company of Toronto, Limited, Toronto, Ont., publishers of the ELECTRICAL NEWS, before the first day of October, 1899.

A competent judge has been chosen to decide the competition in accordance with the method explained above. This gentleman, whose name will be given at a later date, will no doubt be acceptable to all concerned.

The result will be published as soon as possible after the close of the competition.

The publishers of the ELECTRICAL NEWS reserve the right to publish such of the theses submitted as in their judgment may appear to be desirable for that purpose.

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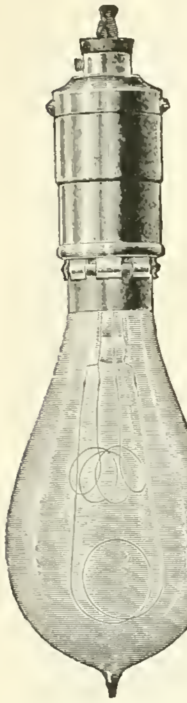
*Paper read before Hamilton No. 2 C. A. S. E.

NEW REGULATING LAMP.



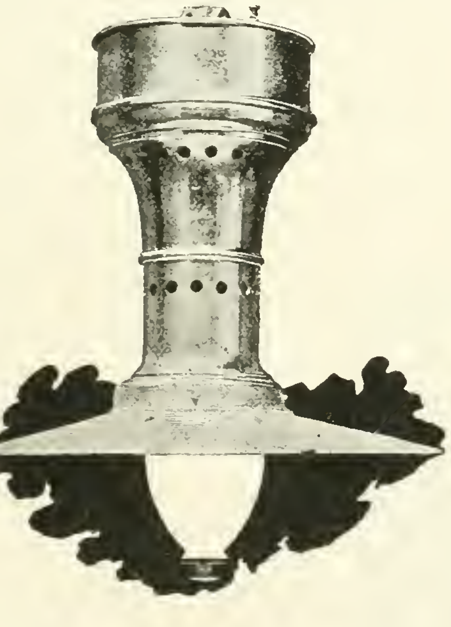
The Truitt regulating lamp which has just been placed on the market in Canada appears to be likely to fill a need which exists among electric light consumers, viz., that of being able to regulate the light of each individual lamp without having to pay for more current than is being used.

It is claimed for this lamp and socket, of which we give an illustration herewith, that it contains no coils whatever, consequently being vastly superior to the old style of regulating sockets, the coils of which were liable to become damaged or burnt out, and also wasting considerable current unnecessarily.

By using two separate filaments a slight turn of the lamp in its socket gives, first, a one candle power light suitable for a sick room or as a night light; the next light is eight candle power, then 16, and then 24, this being arranged by the different contacts in the socket connecting either of the two filaments separately or in series or multiple. A special socket is required so as to enable the lamp to be turned either way. No key or switch is used, as a further turn of the lamp cuts off the current entirely. We understand that Messrs Ness, McLaren & Bate, of Montreal, control the sole agency for Canada.

A NEW COMPETITOR FOR THE INCANDESCENT GAS LAMP.

We take pleasure in illustrating below a new competitor for the incandescent gas lamp, in the form of an enclosed arc lamp made in very miniature dimensions, and of an exceedingly neat and original design. This "Tiny Lamp," which is rapidly replacing cluster incandescent lamps, is only thirteen inches in length, and consumes only 275 watts per hour, giving about eight hundred candle power, and using considerably less current than the average cluster incandescent lamps, and less than one-half of the amount used by the regular standard enclosed arc lamps made by the same company.



The station managers in many places are using these lamps in show windows and for store lighting at the regular prices—flat rate per month for the standard five-ampere enclosed arc lamps—and are claimed to be making a very material saving in operating expenses, while the customer is getting the same amount of light as he would from the large lamp with the double alabaster globes so commonly used. The customer is even better pleased if the central station is willing to reduce his current bill a trifle, and will hasten to explain the advantages of the new light to his friends, with the outcome of much good to all parties concerned. The "Tiny Lihtan Lamps" are made in a variety of styles, and are sold at reasonable prices. At the present time the factory, which is crowded with work, is being extended, and in a short time will have double its present capacity.

In their Tiny Lihtan lamp the manufacturers claim the easiest lamp to trim ever introduced, and a person once using them can readily appreciate the difference between the old and cumbersome methods of getting out the inclosing globes and replacing the new carbons in proper alignment. There is a very effectual automatic "cut-out" in the lamp, which prevents its being injured by letting the lower carbon burn down too far and breaking the inner globe. This is entirely new and original.

These lamps are being turned out in large quantities by the Safford Arc Lamp Manufacturing Co., of Buffalo, N.Y., and immediate shipments can be made. Circulars give prices and further particulars.

ELECRICAL TRANSMISSION PLANT FOR ORILLIA.

By a vote of 399 to 61, the property-holders of Orillia, Ont., on the 6th inst., decided in favor of installing the first long distance electrical power transmission plant in America, if not in the world, which will be owned and operated by a municipality. This plant, the construction of which will be begun immediately, will cost not less than $75,000, and is intended to convey the current generated at the Ragged Rapids, on the Severn river, to the town, a distance of over 19 miles. Eight hundred horse power will be delivered as a first instalment, but the system will have a capacity for delivering 1,000 horse power, and can ultimately be increased to a capacity for 3,000 horse power at comparatively small additional expense.

The hydraulic power was investigated by Mr. Wm. Kennedy, jr., of Montreal, who prepared general plans to govern reception of tenders, and the electrical plant and transmission line were designed by Mr. Roderick J. Parke, consulting electrical engineer, of Toronto, who also prepared the necessary plans and specifications for reception of tenders for these sections.

The contract for the entire equipment has been awarded to the Central Construction Co., of Buffalo, N.Y., at $67,200. The electrical machinery will be furnished through the W. A. Johnson Electric Company, of Toronto, the plant to consist of two 400 h.p. revolving field Westinghouse three-phase 60 cycle generators, each having an overload capacity of 60 per cent., provided with the necessary high tension switchboards and controlling apparatus. Six step-up 100 k.w. static transformers, self-cooling type, will raise the voltage to 22,000 for the transmission line. At the receiving station at Orillia there will be six step-down 100 k.w. transformers, of a similar type, to reduce the pressure to 1,000 or 2,000 volts, so that the alternating incandescent circuits now used for commercial lighting can be connected direct to the above transformers. There will also be provided a 25 h.p. Tesla induction motor, for driving the waterworks pump, now operated by steam, and a 50 h.p. motor of same type to drive the three Ball 25 light arc dynamos, which have been used for street lighting for some years. The switchboard apparatus, lightning arresters, etc., have been carefully selected and so arranged that uniform service and safety in handling can be relied upon, notwithstanding the high voltage.

The Stillwell-Bierce & Smith-Vaile Co., of Dayton, Ohio., are sub contractors for the water wheels.

The plant will be installed under the supervision of Mr. Parke, who will have associated with him Mr. Chas. H. Mitchell, hydraulic engineer, of Niagara Falls, who will supervise the construction of the hydraulic plant at the rapids. The work will be pushed to completion with least possible delay, and it is expected to have the system in operation before the end of October next.

TELEGRAPH and TELEPHONE

NEW C. P. R. TELEGRAPH OFFICES.

The business of the C. P. R. in Winnipeg having outgrown its office accommodation, steps were taken last fall to provide new quarters. The building at the corner of McDermott and Main streets was secured, and remodelled for the purposes of ticket and telegraph offices. A few weeks ago possession was taken by the staff. The installation of the plant, which is one of the most modern and up-to-date on the continent, was superintended by Mr. W. J. Camp, chief electrician of the company. On the ground floor is the city ticket office, the telegraph office, the private offices of the city manager, Mr. John Tait, and the general delivery office and messenger boys' head-quarters. On the second flat is the office of Mr. B. S. Jenkins and his assistants, while the fourth floor contains the large operating room, battery room, and other necessary apartments.

The battery room contains 200 cells of storage battery of the chloride accumulator type, arranged in seven banks of 43 cells, each giving a current of 90 volts. There are also six larger cells used for the purpose of working the sounding or reading instruments. These cells take up the place of 2,400 cells of chemical batteries as used in the old office, effecting not only an economy in space and a saving in cost of maintenance, but giving a much more satisfactory current. It is expected that these cells will last four or five years, requiring during that time scarcely any attention.

The operating room contains 36 sets of instruments. Some of these are what is known as quadruplex, originally invented by Thomas A. Edison, but greatly improved by F. W. Jones, electrical engineer of the Postal Telegraph Company, by means of which four men work on one wire—two sending and two receiving. Thus four different messages are flashing back and forth on the same small wire, with never a collision or sign of confusion.

In order that the operator may hear only his own instrument, it is placed in a small box raised to the level of his ear, a device that does away with the old system of glass partitions. One peculiar feature of the room is the entire absence of wires, these being conveyed to the tables in cables that run under the floor. Above the switch-board is a large number of incandescent lamps, whose peculiar function is to light up when anything goes wrong on any one of the lines. The interruption is thus located without the trouble that would otherwise be occasioned.

The outside wires enter by cables which terminate in a row of porcelain fuse blocks and earth plates. By means of these any abnormal current, such as would be caused by the contact of the telegraph wires with electric light or trolley wires, is arrested and the circuit broken. Lightning is another source of abnormal current which, without these precautions, would ruin the instrument.

The fifty-two operators employed by the company in Winnipeg have means of recreation provided for them in the building in the shape of a reading room and billiard and pool room.

SHORT-CIRCUITS.

Mr. J. P. Gardiner, who has had charge of the Bell Telephone exchange at Kingston, has been promoted to the management of the Stratford office.

Seventeen telegraph poles on the C. P. R. line near Stittsville, Ont., fell down recently, owing the weight of ice on the wires. Telegraphic communication was completely broken off for a time.

A company has been formed to construct a telephone system in the counties of Iverness and Victoria, N. S. The company will make Baddeck their headquarters, and anticipate little trouble in raising the neceesary capital to carry out the project.

Mr. Ruben Stiber, who had been employed in the head office of the C. P. R. for 12 years, died at his home in Toronto recently. He was a well-known musician, and at different times filled the position of organist in some of the largest churches in the city.

Mr. H. P. Dwight, president of the Great Northwestern Telegraph Company, states that the general increase in Canadian business has caused a marked improvement in the business of his company all over the country. People are busy, and in consequence are using the telegraph wires to a greater extent.

The Bell Telephone Company has now about one and one-quarter miles of underground wires in the city of Hamilton. It is said that in the spring steps will be taken to double the present underground system, to meet the requirements of the increasing business and to relieve the pressure on the poles.

The Union Telephone Company, Limited, of Taylorville, N. S., has been organized to construct a telephone line from Middle Musquodoboit to Taylorville. Mr. Edger Archibald is president and Mr. Sidney Lindsey secretary-treasurer.

The Victoria & Esquimalt Telephone Company are about to make some improvements in their system at Victoria, B. C. A new switch-board will be installed, and as soon as this is placed in position the puttting in of a metalic circuit will be commenced.

A settlement has been reached between the Grand Trunk Railway and their telegraph operators. The result is, we understand, satisfactory to all concerned. The minimun salary will be as follows: Agent and telegrapher with dwelling, light and fuel, main lines, $38; branch lines, $35. Agent and telegrapher, without dwelling, fuel and light, main lines, $43; branch lines, $40. Telegraphers, main lines, $38; branch lines, $35; relieving agents who are on the permanent staff and are telegraphers, main lines, $50, branch lines $50.

The prospectus was issued in England recently of the Canadian, British Columbian and Dawson City Telegraph Company, Limited, with a share capital of £300,000. The directors are: Sir James Grant, Sir A. P. Caron, Ottawa; J. H. Turner, M.P.P., Victoria, B. C.; Alderman J. Hyde, Mayor of Banbury; W. P. J. Fawcus, M.I.C.E., M.I.E.E., director Edison & Swan United Electric Light Company, London. The consulting engineer is Sir T. S. Tancred, Bart., C. E.; resident engineer, E. G. Woodford, C. E., late state mining engineer, Transvaal; secretary, W. Young, 64 Victoria Street, London.

SPARKS.

The village of Kamloops, B. C., will probably purchase another dynamo for the electric light plant.

At Whitby, Ont., there is said to be a feeling in favor of installing a municipal electric light plant.

The Ottawa Street Railway Company are said to be considering the extension of their road to the rifle ranges.

Harry Pope, of Peterborough, Ont., while engaged in wiring a building in Montreal, fell a distance of 15 feet, breaking both his arms.

At the Parliament buildings, Toronto, a competitive test was recently made of the steam producing qualities of coal and compressed peat.

The Montreal Island Belt line Company have contracted with an ice dealer for the transportation of 35,000 blocks from Bout de l'Ile to Moneau street.

Mr. W. Sills, an extensive mica dealer of Chicago, announces that he has made arrangements in European countries for the reception of a large quantity of Canadian mica. The mica will be shipped direct from the mines near Ottawa to the European markets, and it is hoped to be able to compete with the India supply, which, on account of the cheapness of labor, is sold at a low figure. The methods of mining and transportation in India are crude, the entire operation being performed by hand. For this reason the Canadian product, worked by modern methods, should have the advantage in price on the European market.

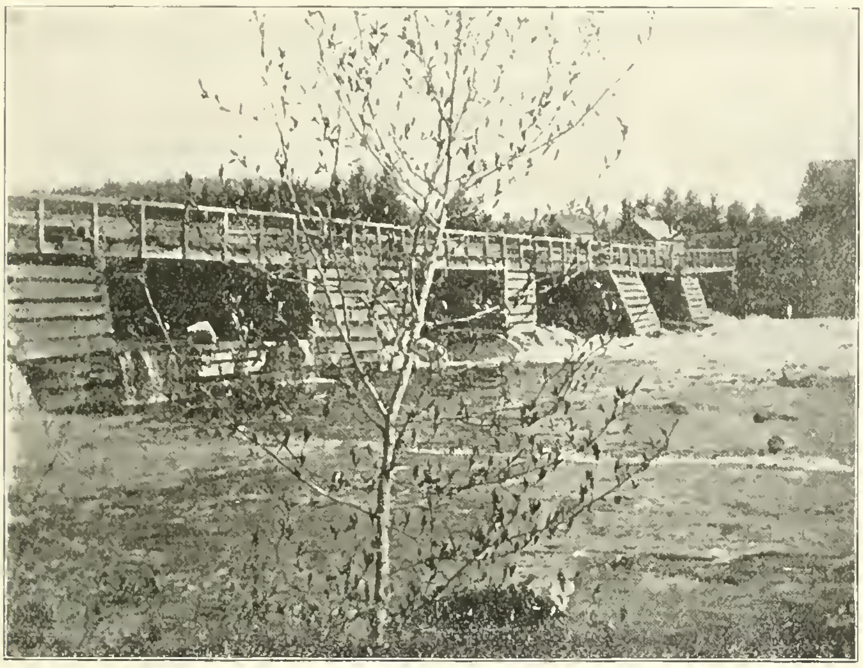
A neat automatic oiling device for the ordinary four-bar guides and crossheads of steam engines is made by drilling a hole through from side to side of the crosshead jaws through the middle of the wrist pin, tapping one side for an oil cup and the other for a plug. Then drill a hole in the top face of each jaw and one in the top of the wrist pin to intersect the long hole. If the pin is larger than the thickness of the jaws, plane a groove across the top of the hole to make the top of the three holes on the same level. The overflow will oil the top guides and pin. Another hole in each jaw clear through will conduct the oil to the bottom guides. A self-feeding oil cup or a wiping device can be used according to choice, or soft grease may be used instead of oil by having the holes drilled, the jaws intersecting the long hole, and by having a spring greace cup.

Acting under authority from the goverement, Mr. Phillips recently made an inspection of the Port Arthur Electric Railway. He has made a lenghty report on the condition of the road. He finds that on some portions of the line within the limits of Fort William there is no planking inside or outside the rails, and that on other portions the planking is in very bad condition, that the rails in places are about street grade, and the earth filling below the level of the rails, and that the ends of the ties are exposed. At some street intersections there are no crossing planks. Frogs at turnouts are not packed as required by law. The trolley wire, No. 4 copper, is too small, and it appears from the number of splices that there has been considerable trouble with the wire breaking. At places the wire is too low, being only 12 to 14 ft. above the rails, on account of the span being slack, the poles on the sides of the streets leaning toward the roadways owing to the soft nature of the soil, or imperfect setting. There is no guard wire over the trolley wire to protect telephone and telegraph wires from contact with the trolley wire. A great number of the insulators used in attaching the trolley wire to the span wire are in bad condition, and must allow the spad wires to become charged with electricity in a number of places.

WATER POWERS OF ONTARIO.*

By Thomas W. Gibson.

If Mr. Tesla's conclusion be correct, namely, that a waterfall affords us the most advantageous means of getting power from the sun for all our wants, excelling for this purpose not only muscular force, but wind and steam as well, the rocky uplands of northern and western Ontario may yet be reckoned among the most valuable parts of the province by reason of the vast number of waterfalls situated there. The main watershed dividing the system of the great lakes from that of Hudson bay runs in a northwesterly direction from the eastern boundary of the province north of lake Temiscamingue to the head of lake St. Joseph, on the northern boundary, a distance of about 500 miles. It consists of a tableland or plateau rather than a sharply defined ridge, and is estimated to have an average width of about 70 miles, or an area of about 35,000 square miles, thus with the slopes on both sides affording an extensive catchment surface for the streams running to the north and south. Its elevation will average perhaps 1,400 or 1,500 feet above the level of the sea, or 900 feet above lakes Huron and Superior. In places it approaches the shore of the latter lake, and for the greater part of its extent is situated at a comparatively short distance from either of these bodies of water. The consequence is that the rivers and streams which flow from it into the great lakes, though mostly of considerable volume, are not of great length, and their descent is therefore usually rapid and abrupt, and marked in many places by cascades and falls.



Lower Dam and Bridge at Palmer's Rapids, on the Madawaska River.

The value of a river of given volume for purposes of water power does not altogether, or even chiefly, depend upon the amount of its fall from source to mouth. Of course, the greater the fall the greater the energy possessed by the stream as a whole. But it is apparent that if the descent be gradual and uniform, or approximately so, there will be few places in its course where the fall is large enough to afford any considerable quantity of power. It is only where sudden falls or rapids occur, which create a decided difference in the level of the water, that the energy of the river is concentraded, as it were, within a short space, and can be utilized. The nature of the soil or surface of the country through which the river runs has an important effect in influencing the habit of the stream in this respect, and so determining its value as a producer of power. If it be composed of sand, clay, gravel or even the softer or more easily decomposed rocks, it will usually be found that the river has worn its bed to a fairly uniform slope throughout, in which case there will be few opportunities of developing power from its waters. Even if a slight drop should occur, a dam would probably be required in order to obtain any considerable head, and the erection of dams, while often necessary and advantageous, involves additional expense both in construction and maintenance. In a river whose bed is composed of hard rock, such as is usually comprised in the Laurentian and Huronian formations of northern and western Ontario, the eroding force of the water meets with much greater resistance, and its course is more likely to be marked by abrupt changes of levels in rapids and falls, and indeed this is characteristic of many if not most of the rivers in those parts of the province. Another prominent feature of the topography of these districts is the very large number of lakes, varying in size from mere ponds to large and important sheets of water. These are either

Section of Lower Dam and Bridge at Palmer's Rapids.

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* From the report of the Ontario Bureau of Mines.

the sources of or tributary to the rivers, or expansions of them, and act as reservoirs or storage basins, tending to regulate the flow of the water and to render it constant and steady throughout the year.

The character of the country in northern and western Ontario is therefore such as to provide an almost illimitable amount of water power readily available. Taking into account the annual precipitation of moisture in the form of rain and snow, there is no reason to doubt that hundreds and thousands of horse power could be generated from the waters of streams flowing into the great lakes with a minimum of trouble and expense. A shorter watershed running from the main one southwesterly round the western end of lake Superior divides the streams falling into that lake from those which find their way into lake Winnipeg and so into Hudson bay, and the waters running in both directions from this divide furnish many fine water privileges, similar in character and equally available; while tributary to the Ottawa river, and in that part of the province included within the boundaries of Algonquin National Park, as well as to the south and west, are numerous rivers of considerable fall and volume, from which a very large additional amount of power could with little difficulty be obtained. The streams flowing into Hudson bay, such as the Albany, Kenogami, Missinaibi, Mattagami and Abitibi are of greater average length than those running into the great lakes, and as they descend to the level of the sea, say 600 feet below that of lakes Superior and Huron, many falls are to be found upon them, particularly in their upper reaches and in the neighborhood of the "long portages," where their waters are interrupted by the hard rocks of the old formations on their way to the more level Devonian plains bordering on James Bay. For the present, however, these rivers are too remote to be regarded as sources of available power, though the time may come when they will be called into requisition.

On the Seine, Atik-okan, Wabigoon, Winnipeg and Rainy rivers; on the Mattawin, Kaministiquia, Nipigon, Steel, Pic, Magpie and Michipicoton; on the Mississaga, Thessalon, Spanish, Vermilion, Wahnapitae and Sturgeon; on the Montreal, Ottawa, Petawawa, Bonnechere and Madawaska; on the Muskoka, Magnetawan and Severn; and on many others, there are numerous falls and rapids waiting to be utilized and capable of doing the work now being done by all the steam engines in Ontario a hundred or a thousand times over. This is leaving out of view the waterfalls already developed and in use in the older portions of the province, as well as the stupendous energies of the falls of the St. Mary and Niagara rivers, which are already, one on the Canadian and the other on the American side, to some extent made use of.

PRACTICAL USES OF POWER.

The rivers enumerated above are situated among the forests of pine and hardwood which cover so considerable a portion of New Ontario, and in many cases they are contiguous to valuable deposits of ore or mineral. The raw material for many industries lies around them. The sawmill, planing mill, sash and door factory, pulp mill, match factory and many other wood-working industries might happily combine abundant raw material and cheap power on these streams, while stamp mills and other mining plants might be worked with profit and success. Other industries, such as woollen, cotton and flour mills and chemical manufactories, might avail themselves of the cheap power without necessarily locating in the immediate neighborhood of the waterfall, by connecting themselves with it by means of the electric current, though for textile, paper and other industries whose processes necessitate the use of large quantities of clear water, a waterfall convenient to means of transportation forms an ideal site. Electrically driven railways seem likely to come into vogue in this and other parts of the world because of their low first cost and inexpensive maintenance, and it appears feasible to operate electric roads by currents generated by the waterfalls on the rivers in many parts of the districts referred to. Such railways might serve a very useful purpose in carrying lumber, ore, raw and finished material and supplies of all kinds in a country where perhaps the volume of traffic might not be sufficient to render an ordinary steam railway a profitable undertaking.

Water power, whether employed directly to operate machinery, or converted into electric energy for the same purpose, has many advantages over the steam engine. For the same quantity of power, its first cost is not usually much greater, and often not so great, and once installed it requires little or no attention. Its danger to life and property is less. It needs no fuel, a consideration specially important in Ontario, which has no coal beds, and where in time even the present abundant supplies of wood will be exhausted. Hitherto the chief disadvantage of water power has been its immobility. If a waterfall was not conveniently situated, it was of little or no use. If it did not pay to place a manufactory alongside a waterfall, the fall could not be brought to the factory. Now this has to a large extent been changed, and power can be delivered without serious waste many miles from where it is electrically produced. The change will be still more marked when the problem of transmitting electric energy through long distances has been thoroughly solved, and Nikola Tesla looks forward to a speedy solution.

The presence of so many available water powers in the Lake of the Woods, Seine river, Wahnapitae and other mining districts of Ontario is a fortunate circumstance and cannot but have a very favorable effect upon their development. Cheap power means economy in working, and will permit of ore bodies being profitably utilized which would otherwise not pay for treatment. The immense deposits of low grade ore which are found north of lake Superior and on the Upper Seine are in many cases situated in proximity to waterfalls capable of yielding hundreds and thousands of horse power at comparatively little expense. The importance of preserving these water powers as far as possible for the general benefit and preventing their being locked up in the hands of speculative individuals who would not use them themselves, but who would demand heavy toll for their use by others, has led to the adoption of new regulations under the Act respecting Water Powers, (61 Vict., chap. 8) passed at the last session of the Legislature. The principal features of these regulations are those which provide for the leasing of such powers by the Crown, instead of patenting them outright, and for the furnishing of surplus power by the lessee to others on terms to be fixed in case of disagreement by the Lieutenant-Governor in Council.

The full text of the Act, which was assented to January 17, 1898, and of the regulations, which were apopted by order-in-council dated June 21, 1898, is as follows :

AN ACT RESPECTING WATER POWERS.

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of Ontario, enacts as follows : The Commissioner of Crown Lands may reserve from sale any water power or privilege on the Crown Lands of the Province, and a sufficient area of land in connection therewith for the erection of buildings and plant, together with the right to lay out and use such roads as may be necessary for passage to and from such water power or privilege and land, and may under regulations be approved by the Lieutenant-Govenor in Council make terms and conditions upon which such water power and land so reserved may be sold or leased, and developed.

REGULATIONS RE WATER POWERS.

1. These rules and regulations shall not apply to water privileges which in their natural condition at the average low stage of water have not a greater capacity than 150 horse power.

2. In granting or leasing otherwise than under these regulations any Crown lands upon which a water privilege is situated, the said privilege shall be reserved to the Crown, together with such an area of land in connection therewith as shall in the opinion of the Commissioner of Crown Lands be required for the proper development of the same, and the construction of all necessary dams, weirs, tunnels, races, flumes, sluices, pits and other structures of works, and the erection of buildings and plant for the employment and utilization of such privilege, and storing grounds and yards in connection therewith ; and there shall also be reserved in any such grant or lease the right to flood any such portion of the lands so granted or leased upon compensation to be made to the owner or lessee thereof by the person or persons to whom such privilege shall afterwards be leased ; and the said water privilege, land and right so reserved shall form a separate property to be dealt with as hereinafter provided.

3. The right to lay out and use such roads as may be necessary for the passage to and from such water privilege or land shall be reserved in all grants or leases of contiguous or adjoining lands.

4. The applicant for a water privilege situated on Crown lands shall, if necessary, file in the Department of Crown Lands a plan and field notes by an Ontario land surveyor of survey thereof ; and also a statement setting out :

(a) The location of the water privilege applied for, and a description of the land required in connection therewith.

(b) The height of the fall or rapid, the volume of water at the average high and low stages of same, the estimated capacity in horse power of the fall or rapid in its natural condition at the average low stage of water, the height of the dams or weirs (if any) which it is proposed to construct, and the increase in the level of the water which such dams or weirs will bring about.

(c) The nature and location of the business, plant or manufactory in connection with which it is proposed by the applicant to utilize the water privilege, and the number of horse power which the applicant proposes to develop and use (1) within two years, (2) within five years.

(d) The plan by which the applicant proposes to develop the water privilege, showing the dams, weirs, tunnels, races, flumes, sluices, pits and other structures of works which it is proposed to build or make in connection therewith, the estimated cost thereof, and the form in which the power is to be used or transmitted, that is, whether by direct energy, electricity, compressed air, etc.

(e) The land or lands which would be over-flowed or otherwise affected by the raising of the water or the construction of the dams, weirs, sluices, races or other works in connection with the development or use of such water privilege and the owner or owners thereof.

5. The Commissioner of Crown Lands shall have power to call for measurements, plans, specifications, descriptions, levels, profiles, elevations and all such other information as he may deem necessary for the proper consideration of the application, which shall be furnished at the applicant's expense. The plans and specifications for the construction of the necessary dams, weirs, tunnels, races, flumes, sluices, pits and other works for the development of such water privilege shall be submitted to the Commissioner of Crown Lands, if so required by him, and such works shall not be proceeded with until the Commissioner has approved the plans and specifications.

6. The applicant shall submit such proof of his financial standing and ability to develop the said water privilege as shall be satisfactory to the Commissioner of Crown Lands.

7. On approval by the Commissioner of Crown Lands of an application for a water privilege, he may order a lease of same to issue therefor, such lease to be for a term of ten years, with the right of renewal for a further term of ten years at the same rental, if the covenants and conditions have been performed and fulfilled, and thereafter with the further right of renewal for a term of twenty years upon such terms and conditions and at such rental as may then be provided by law or regulation.

8. The rental under any such lease shall be such sum as may be fixed by the Commissioner of Crown Lands, and shall be payable yearly in advance. Where application is made for the right to develop not more than half the maximum estimated capacity of a privilege at the average low stage of water as aforesaid, and where the granting of such application would not prevent or interfere with the development by other parties of the remaining capacity of the said privilege, the Commissioner may grant the same and may, if he thinks proper, reserve a portion of the land connected with the water privilege, provided that in any such case the Commissioner may issue a lease or leases for the remaining capacity of the said privilege, and the remaining lands connected therewith.

9. The right of timber owners and other to drive their logs down any river, stream or other body of water, as now by law established, shall not be interfered with, lessened or restricted by the granting of any such lease ; and if any dam, weir or other structure be erected or built in connection with the development of any such privilege, with the object, intention or effect of damming the water or impeding the flow thereof, full and proper provision as now by law required shall be made by the lessee for the passage of logs and timber over and through same.

10. The lessee under any such lease shall not destroy or obstruct the navigation of any river, stream or body of water previously navigable, but shall provide such locks, canals, passages and other means as may be necessary for the proper and safe surmounting or passing of any dam, weir or other work made or erected by the lessee.

11. The lease shall provide—

(a) For the development and use within a period to be named in the lease of at least one-half the power proposed to be developed and used, and for the development and use of the full capacity of the privilege estimated as aforesaid, or of the remainder of the power proposed to be developed and used as the case may be, within a further period to be named in the lease.

(b) For the use by other parties than the lessee of surplus or unused water or power not required by him for the purposes of his business, plant or manufactory on such terms as may be agreed upon ; and failing an agreement between the parties as to the terms and conditions on which such surplus or unused water or power may be used, and the remuneration to be paid therefor, the Lieutenant-Govenor in Council shall have power to fix and determine the same, and any Order in Council fixing such terms, conditions and remuneration, shall be final and conclusive and binding upon all parties concerned.

(c) For the erection and maintenance by the lessee of a durable and efficient fishway when so required by the proper officer or authority in that behalf.

(d) Failure or refusal of the lessee to comply with the conditions of the lease, or default in payment of the yearly rental for ninety days after the same falls due, shall work a forfeiture of the lease.

(e) During a continuance of the lease, the lessee shall keep and maintain all dams, weirs, tunnels, races, flumes, sluices, pits and other structures and works necessary for the development and use of such privilege in good repair and condition, and shall not wilfully or otherwise injure or destroy the same or any part thereof, but at the expiry or sooner determination of the said lease, shall leave all such structures and works in good repair and condition, and so that their subsequent usefulness shall not be lessened by any act of the said lessee.

(f) At the expiry or sooner determination of the lease, the water privilege shall revert to and become the property of the Crown as fully as if no such lease had been granted, together with all dams, weirs, tunnels, races, flumes, sluices, pits and other structures or works made or erected by the lessee in connection therewith, and all buildings erected on land covered by the lease ; but the lessee shall be allowed a reasonable time to be fixed by the Commissioner of Crown Lands in which to remove all machinery employed by him in the development and use of the privilege, failing which removal such machinery shall become the property of the Crown.

(g) Where there is more than one applicant for a water privilege the Commissioner of Crown Lands may, at his discretion, put the same up at public auction or tender, subject to the foregoing conditions, to be awarded to the highest bidder or tenderer for a lease thereunder.

(h) If at any time or times after the water privilege has been developed, either in whole or to the extent to which the lessee is bound by the lease to develop the same, the said lessee shall continuously neglect for the space of one year effectually to produce power from the said privilege, either for his own use or for that of other persons, unless hindered by unavoidable accident, the Lieutenant-Governor in Council may order and direct the said lease to be forfeited and cancelled.

12. Where a water privilege is applied for by a municipal corporation for the purpose of supplying water, power, light, or heat for the use of the inhabitants thereof, the Commissioner of Crown Lands may issue a lease of said privilege to such corporation if otherwise entitled to receive and hold the same, on such special terms and conditions and at such rental as he may deem proper.

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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Mr. Tesla and His Critics.

FOR having been so bold as to call in question some of Mr. Nikola Tesla's recent statements before the Electro-Thereapeutic Society, the New York Electrical Engineer has called down upon its head a storm of personal abuse from the pen of the erstwhile brilliant experimenter and inventor. It is gratifying to observe that some of the leading electrical journals refuse to print the illogical and abusive epistles which Mr. Tesla is seeking to hurl at the heads of the editors who have offended him. The fact is that Mr. Tesla has of late talked a great amount of nonsense, which, nevertheless, owing to the position which he occupies, or has occupied, is calculated to temporarily unsettle the value of electrical investments. He has promised to do a great many things which he has failed to do, and in consequence has lost caste with the electrical fraternity. It was time that he should be "called down," and the Electrical Engineer is entitled to credit for having performed the disagreeable task in a gentlemanly manner.

Electric Railway Development in Toronto.

IMMEDIATELY following the approval by the citizens of Toronto of a by-law authorizing an expenditure of $150,000 for the building of a public market, comes the proposal of the Toronto Railway Company to construct a system of radial electric lines connecting the city of Toronto with all parts of the county of York. Whether viewed from the standpoint of the city resident or of the farmer living in the county, the carrying out of both these enterprises seems to be highly desirable. It is somewhat doubtful whether a modern market established on so large a scale as is proposed could be successful in the absence of a system of radial electric lines which would make tributary to it the products of one of the richest agricultural counties in Canada. On the other hand, the market is almost if not quite as important an adjunct to the success of the electric railway enterprise, as the necessary freight cannot be obtained unless an outlet be provided for its disposal in Toronto. The success which has attended the operation of the Hamilton, Grimsby & Beamsville road affords strong foundation for the belief that a system of radial lines, having as their terminus in Toronto an extensive and well managed public market, would be certain to prove a paying investment.

Niagara Power.

Buffalo capitalists are reported to have engaged the President of the Franklin Institute, Mr. John Birkenbine, to prepare plans for the utilization and transmission of 35,000 h.p. from the Whirlpool Rapids below Niagara Falls. At this point, where the speed of the current is 21.75 miles per hour, it is proposed to divert five per cent. of the flow of water through a canal to be built inside the tracks of the Gorge road. The scheme is no doubt a feasible one. The greatest problem would seem to be to find a profitable market for so much power in addition to that which is now being produced at the Falls. Representatives of New York and Philadelphia capitalists waited upon the Commissioner of Queen Victoria Niagara Falls Park on the 4th inst. for the purpose of seeking to acquire the power franchise now held by the Cataract Construction Company, in case the present holders should forfeit their rights.

Fires from Electric Wires.

Either maliciously or through ignorance, the Fire Commissioners of Montreal have, in their annual report, endeavored to injure the business of electric lighting in that city, by attributing to defective wiring the bulk of the fires which occurred in buildings in the year 1898. The statements made by the commissioners are so unreasonable as to require no refutation by the trade, and it is probable for this reason that no action has been taken. Of a total fire loss during the year of $1,382,753, the commissioners attribute to electricity a loss exceeding $1,000,000, in the following words: "During the last year from this source alone the losses by fire have been greater by over $1,000,000 than from any other causes." The statement made is absolutely and unqualifiedly untrue. There is no basis or warranty for the statement that electric wires have caused greater losses than other causes, and particularly is there no basis for the statement that the losses from electric wires have been greater by one million dollars than by any other causes. If the statement concerning electric wires were true, then the losses from all other sources would be less than $383,000. The report states the number of fires investigated to have been 567; the number alleged to have been caused by electric wires 29, or only about 5 per cent. of the entire number. If the 29 fires alleged to have been caused by electric wires caused a loss of over one million dollars, that would mean an average loss per fire of about $35,000, whereas the losses from the other 538 fires would average only about $700 per fire. As a further evidence that the report is not based upon facts, we may say that the Fire Underwriters' Association at Montreal is not willing to incur the expense of a corps of inspectors for electric light wiring, and the insurance companies will not refuse to give insurance to parties who have not received a certificate from the Board of Fire Underwriters that their wiring is in accordance with the rules and regulations. The Board of Fire Underwriters do not believe that the danger to be apprehended, as determined by their experience in the past, is sufficient to warrant their incurring this expense, and in fact, the committee of the Canadian Electrical Association who have taken up the matter of underwriters' inspection have been unable to make any progress with the underwriters because of their apathy on the subject. If it were true that the 29 fires alleged to have been caused by electric wires had caused a loss of more than one million dollars the public might rest assured that in self defense the underwriters would take hold of the matter vigorously; as it is, the only inspection that is insisted upon is that which the operating companies themselves undertake to apply. We trust we have said sufficient to show the utter absurdity and untruthfulness of the report. We observe that the Canadian Fire Underwriters' Association has submitted a memorial to the Montreal City Council urging that body to obtain the necessary legal authority to have all electric wiring executed under the supervision of an inspector, to be paid by means of a small inspection fee. It is very improbable that any resistance would be offered to the course by the competent wiring contractors, who are equally interested with the public and the insurance companies in securing perfect work. Those unable to do such would be forced out of the business, to the advantage of all concerned.

Canadian Electrical Association.

The Executive Committee of the Canadian Electrical Association especially desire that the coming Convention, to be held in Hamilton, Ont., in June, shall be of the utmost practical value to every member, whether operator, manager or owner of an electrical enterprise. With that purpose in view, it is intended that the subjects of papers to be read and submitted for discussion shall be those which appear to the members to be of most interest and of practical utility. Request has been made of the members to advise the Secretary what topics they would like to have discussed, and from what point of view. Already a number of valuable suggestions have been received, as well as the promise of several papers. A meeting of the Executive Committee will be held at an early date to consider the necessary arrangements for the approaching meeting and appoint sub-committees to carry them into effect. It will be remembered that Hamilton was the scene of the first convention of the Association. Since then the city has become the home of many important electrical enterprises. The Hamilton, Grimsby & Beamsville Electric Railway stretches a distance of more than twenty miles through the vineyards and orchards of the Niagara Peninsula; the Hamilton & Burlington Electric Railway operates between the city and the far-famed Burlington Beach; the Hamilton & Dundas Electric Railway affords the visitor views of the picturesque Dundas Valley. The Bell Telephone Company's exchange, which so interested the members at the former convention, has since undergone many improvements, and is an up-to-date object lesson in telephony. In addition to these and other interesting features of the city which might be mentioned, full opportunity will be given to inspect the entire equipment of the Cataract Power Co., described and illustrated in these columns recently. Those of our readers connected with any department of the electrical industry, who may not yet have become members of the Canadian Electrical Association, should join now, and share in the pleasure and profit of the approaching convention.

The Corporation of the Town of Bothwell have awarded a contract to the Canadian General Electric Co., for a 500 light plant, to be used for commercial and street lighting purposes. The lighting of the streets will be done by 15 enclosed arc lamps, of the latest type, which will be operated from the same machine.

MONTREAL

(Correspondence of The Canadian Electrical News.)

SUBMARINE TELEGRAPHY.

Dr. A. E. Kennelly, of Philadelphia, delivered four lectures at McGill University on January 30th and 31st, on "Submarine Telegraphy. The lectures were extremely interesting, and were largely attended, not only by students of the University, but by electrical people of the city. I am indebted to Prof. Owens, of the Electrical Department of the University, for the following brief abstract:

The history of submarine cable telegraphy is replete with interest, not only to the student of electromagnetics, but also to the student of sociology. Its annals indicate the immense amount of labor which has had to be expended by a large number of men in the best years of their lives' work, in developing conjointly the knowledge and experience which now enables us to set geographical time and space at defiance.

Practically all of this work has been accomplished during the last half of the century which is now about to close. The first submarine cable stretched timidly across the Straits of Dover about the year 1850, consisting of but a single copper wire, insulated with gutta percha. It had no mechanical protection of any kind. Although the cable lasted but a few hours, being destroyed either by the violence of the elements or the hook of an unkind fisherman, nevertheless it demonstrated its electrical capabilities, and paved the way for greater successes in the years to come.

It was not long before shallow water cables spread themselves around the shores of the Mediterranean, and in 1859 the first cable bridged the depths of the Atlantic. This was, indeed, a triumph of electrical engineering at that time, but the triumph was short lived, since the cable died a natural death in a few weeks' time. It was replaced, however, by a far better cable, in 1866, the experience of the earlier trial having come to fruition, and since that time Europe and America have never been beyond speaking distance.

At the present time there are some 150,000 miles of cable laid throughout the world, and a fleet of more than thirty telegraph ships is employed to minister to their needs. Although this length of cable would be sufficient to girdle the world some six times, yet the actual girdle is incomplete at present, at the Pacific ocean, but it is now confidently expected that ere long this gap will be completed by a cable from the western coast of America to China or Japan.

The amount of the capital which has been expended in the enterprise of cable laying will be evident from the fact that cable costs roughly about one thousand dollars per mile.

Enormous improvements have taken place in the speed of signalling or telegraphing through cables, since the ocean was first spanned, a great deal in this direction being due to the inventive skill of Lord Kelvin. The mirror galvanometer instrument, which is so valuable an adjunct in the electrical laboratory, has been yet more valuable to the electrical fraternity in the operating room, as a commercial signaling instrument, while the siphon recorder of later date has caught the fitful flickerings of the beams of light, and has left their record traced upon a moving band of paper.

There is no difficulty in laying a cable anywhere, but there is a considerable difficulty in laying a cable in such a manner as to minimize the risk of its fracture after being laid. It is a matter of experience that wherever a cable rests upon a rock, it will break, and its rupture is only a question of attrition and time. Those who build upon rock, so far as cables are concerned, build to their destruction, while only those who build upon sand can expect dividends. The course on which a cable is to be laid should be thoroughly investigated beforehand, by a ship which makes a zig-zag path over the course, and sounds at frequent intervals so as to insure the provision of a smooth and soft bed, on which the cable shall be laid to rest, otherwise its slumbers will be interrupted by the rude shocks of rupture.

The size of a cable, and therefore to some extent its cost per mile, varies with the depth of water and the nature of the bottom. In deep water a cable is made slender and light; in shallow water it is made of relatively great weight and diameter, with large protecting steel wires to resist attrition.

The speed of signaling does not become any serious consideration until a cable is several hundreds of miles in length; in other words rapid speed of hand signaling can be obtained over almost any kind of practical submarine cable up to a length of several hundred miles, but after a length of, say, five hundred miles has been passed, it is necessary to employ delicate apparatus, and with long cables it is necessary to employ a comparatively large size of copper wire or strand conductor and insulating gutta percha envelope.

There is scarcely any series of engineering operations which has a greater fascination or possesses more romantic interest than submarine telegraphy, in the picking up or repairing of cables. It is governed largely by time and tide and weather, and its fortunes are governed by a great variety of circumstances; nevertheless, cables have been successfully repaired in the deepest water to which they have yet been committed. The expense of repairs in deep water, say in two miles of water, is naturally much greater as a rule than the expense of repairs effected in shallow water, while in some cases very shallow water repairs may be effected in a small boat or sailing yacht, at an expense that is relatively trivial.

COMPETITION FROM UNITED STATES.

We are credibly informed that the contractors for the new London & Lancashire Insurance building, themselves American, have engaged a Boston firm to do the electric light wiring. While this is a matter more nearly affecting Montreal electrical contractors, it evidently affects all Canadian building contractors to know that whilst American workmen can be brought over here, literally taking the "bite out of the Canadian workman's mouth," the alien labor law prevents our returning the compliment and sending our men to do work in the States. Surely "what is sauce for the goose is sauce for the gander," and there should be some way of remedying such a glaring anomaly. The sooner our contractors see to it the better for their own intererts. "Verb sap."

QUESTIONS.

"Subscriber" writes: "I have a General Electric induction fan motor, 16,000 alternations, 52 volts. Tried to run it on 8,000 alternations, 52 volts, by putting kicking coils in series. Kicking coil wound with same size of wire as fields of motor. Leaving the matter of speed out of the question, why should armature of motor heat excessively after a short run, and fields remain cool? On 8,000 alternations, with kicking coil in series, armature appears to be a block of laminated iron with pieces of No. 10 copper wire threaded through."

"Doctor" asks: "Why does sparking with explosive reports happen in mercury cup of Rumkhoff X-ray apparatus? Six cells of accumulators are used, and a subsidiary battery of two cells to work interruptor. Main current appears to enter the Rumkhoff coil via the pillar of the interruptor and mercury contact cup, in which a pointer, attached to arm of interruptor armature, dips. On top of the mercury in cup is placed a layer of alcohol. When interruptor and coil are in action, loud sparks are heard in cup, accompanied by flashing in the Crookes tube."

THE VOLTAGE MAGNIFIED.

In your Montreal news in January there is surely a slight inaccuracy in the item "A Charmed Life." The wire was amply large enough, no matter what its size was, to carry 2,500 volts. The current which it was carrying in amperes was not mentioned, but it would not take much of it at pressure named to seriously injure a man. That the voltage received was actually 2,500 is very much open to question. There was iron wire acting as a conductor, which in itself had considerable ohmic resitance, not to speak of its kick-back effect with alternating current; further, the original contact was probably of an arcing nature, and by no means what might be called "good contact."

THE FIRE COMMISSIONERS' REPORT.

Your correspondent had hoped that an official refutation would have been given before now to the late report of our Fire Commissioners, so far as amount of damage said to be caused by electric wires is concerned, but it has evidently been treated with the silent contempt that such an extraordinary statement merited. The Commissioners must say something to retain their sinecures, and evidently act on the rule "when in doubt, blame electricity." For the satisfaction of your readers, I have interviewed one of the inspectors (whose name, for obvious reasons, I do not give), and one who is competent to give an opinion on this subject, which, with all due deference to them, our noble Fire Commissioners are not. His answer was that "that portion of report was simply ridiculous"—to which I must heartily say "Amen."

NOTES.

One of the "deadly electric wire" fires chronicled in the daily press here as having occurred at the Balmoral Hotel turns out to be from grease upset on a stove. As the idea is popular, however, none of the papers have had the temerity, so far, to make retraction.

The plant mentioned in your "Sparks" column, January issue, for the C.P.R. steamship Alberta, is well under way, the dynamo and switchboard being supplied by the Canadian General Electric Company, and the wiring being executed by the Montreal Electric Company.

Mr. P. H. Hover, representing the New York Insulated Wire Co., was in Montreal lately, reminding his friends of the fact that rubber covered wire is "moving up," and that rapidly. He seemed to have his pockets well filled with orders, judging by his jovial smile.

Mr. White-Fraser apologizes for his late comments on the London specifications. Although late in one sense, they are indeed timely, as, judging by conversation here, your correspondent can safely say that he has struck the mark by calling a "spade a spade," and the trade applaud his criticism.

Mr. S. A. Chase, of the Western Electric Company, New York, was in Montreal last month. He reports business booming, his company having lately purchased more land and intend building at once a factory larger than either that on Thames street or Bethune street. Mr. Chase is managing the Canadian Bryant Company's factory in Montreal at present.

Mr. Hallberg, of the Standard Thermometer Company, of Peabody, Mass., paid a visit to this city a fortnight ago. He spent most of his time at the headquarters of his Montreal agent, Mr. John Forman. Mr. Hallberg is a Swede by berth, and well posted in matters electrically. He is the inventor of the Upton arc lamp, enclosed type, which is already to be found in many places of business in Montreal.

Of ill luck the Lachine Rapids Hydraulic & Land Company have had more than their share. After keeping up service through particularly trying weather, such as 20° below zero one day and 40° above the next, they have had their "head" lowered by a jam occurring, which has raised the water, and which does not seem to want to move off quickly by aid of nature alone. It is hard luck, and they have the sympathy of the public at large; meanwhile, "it is an ill wind that blows nobody good," and the Royal Electric Co., their opponents in the field, are reaping the benefit of the misfortunes to the Lachine Co., which, however, now appear to be about at an end.

SYSTEMS OF METER RATES.[*]

By Edwin L. Debell.

THE study I have been able to give this subject has greatly increased its importance in my estimation, and impels me to urgently advise all central station operators to give it more serious consideration than it has yet received. We all know that our properties are operated at a poorer rate of economy than any other class of power plants, being in effective operation only a few short hours out of each twenty-four. Have we given due consideration to the cause of this defect; what means, if any, be employed to remedy it, and a surprising amount of benefit would result thereby to ourselves and our customers? I think not, and the object of this paper will be an attempt to show how these conditions are effected by the systems of rates employed.

The contract, or flat rate system, although still in quite extensive use, is neither logical or satisfactory. In the early days of electric lighting the service was employed mainly in the business places, and only the number of lights needed for regular daily use were installed; lamps were all of one size, and the station usually run until twelve or one o'clock at night. Under these conditions, flat rates were fairly successful, and could not be greatly abused. The fixed charges on the property, however, were very high for each hour of operation, and high rates had to be charged.

Nowadays the use of the service is more varied. Business places require a large number of lights for display and other occasional use, and we are called on to supply current to dwelling houses, shops, churches, halls and other intermittent consumers. Lamps are supplied in sizes from 2 to 50 c. p., and most of our stations are now operated all night, if not the entire twenty-four hours daily. Under these changed conditions, the flat rate privileges can be, and are, grossly abused. The central station is not only compelled to supply a large quantity of current for which no pay is received, but also to invest additional money in machinery to supply it.

The justice of charging each customer for the exact quantity of current used, and the employment of suitable devices for ascertaining that quantity, cannot be questioned. The number of recording meters installed within the past few years, and the constantly increasing use of them, indicates clearly that this is generally accepted as the true basis on which to frame the charge for electric current.

This proposition being accepted as true, we now come to the main question involved in this paper. What system of rates will be most just and satisfactory to our customers, and at the same time maintain and improve our present earnings?

First, let us study prevailing methods and see if they are founded on the true cost of production. The usual custom is to charge a fixed rate per unit, with discounts proportionate to the quantity used. The rate per unit has been determined either by the present average cost of the total units produced, by estimation, or by the rates in most general use by others. In any case, the cost has been made to include all fixed expenses on the property, such as interest, taxes, insurance, management, clerical work, etc., and which generally amount to 75 per cent., or more, of the total cost of each unit produced. As the great bulk of the station's output is accomplished in three or four hours of heavy load each day, a like proportion of the fixed expenses are charged against that period. Thus, according to our own calculations, each of the remaining twenty or twenty-one hours has to stand but a small fraction of the fixed expenses, yet we charge our customers the same amount for each unit used in those hours as in the heavy load period. The process is one of average, and does not distribute the expense ratably to each customer.

It may perhaps be claimed that the process is fair on account of the manner in which we have to operate our stations, but it is a matter of great doubt whether this manner of operation is responsible for the present system of rates, or if the rates are responsble for the poor operation.

When we charge nearly all of our fixed expenses against the current used during a few hours, and then assess it again on each unit used in the remaining hours, it makes the cost of the service especially burdensome, if not prohibitive, to those using it for long hours at a time. These customers are the most valuable to the central station, and should be encouraged by every possible means. We should do everything we can to keep them, and to secure more of them, as they keep our investment employed a longer time each day and add to our receipts, without any increase whatever in our fixed expenses, and very little in running expenses.

Let us study how a system of differental rates would affect this question. In order to apply such rates we first have to determine the total cost of production per unit, including fixed and running expenses of every kind. Next determine how much of the cost is for fixed expense and how much for running expense. If exact records of the costs have not been kept, a close enough estimate can undoubtedly be made to answer the purpose. It will be found that the running expenses form but a surprisingly small portion of the whole. This is not a supposition or guess work, but has been proved by the records of many well conducted stations.

The report of an examining board to the authorities of Aberdeen, Scotland, in 1897, gives some very interesting arguments on this feature. They refer to the poor fate of economy of the electrical plant owned by that city, and compare it with their gas works. They show that the former has to install and hold ready for use generating machinery sufficient to meet the maxium requirements of all their customers at any given moment; that their plant had a capacity, if run twenty-four hours daily, the same as the gas works, sufficient to supply three and three-fourths millions units per year; yet in the preceding year, only 214,000 units, or less than 5¾ per cent. of the capacity of the works, had been supplied. A load diagram of the station was shown, almost identical with those common to our own stations. The opinion of the board was that this unfavorable condition would be improved by a varying or differential system of rates, based on the true cost of production and giving discounts according to value of the customer to the station, in contradistinction to the total quantity consumed.

They submitted a statement showing a comparison between their best and worst customer for the preceding year. The best was a comparatively small consumer of current, employing less than two horse power of the station's capacity, less than $400 of its capital, and chargeable with but $27.50 of the annual capital charges. He employed the service for 2,000 hours during the year, however, producing a revenue of $288, or about $260 over capital charges.

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[*] Paper read before the Northwestern Electrical Association.

The other employed 177 h. p. of the station's capacity, nearly $37,000 of its capital, and was chargeable with $2,582 of the annual capital charges. He used the service 61 hours during the year, paying therefor $823, or less than one-third of his portion of capital charges.

These are undoubtedly extreme cases, one showing a very large load on the station for about twelve minutes, and the other a small load for six and two-thirds hours per day for 300 days in the year. The system of rates recommended by the board would compel the larger customer to pay a very much higher rate, or to abandon the service and make way for customers of the other class, who would be encouraged by the lower rates the system would give them.

Mr. Arthur Wright, electrical engineer to the corporation of Brighton, England, and originator of the Wright demand indicator, gives some figures covering the ratio of fixed and running expenses in the Brighton plant, in a phamplet published in 1896.

To show what a small portion of the total cost of production lies in running expenses, and why it follows that the output of a station can be enormously increased with only a small addition to total expenses, he has selected and given figures on two periods of three months each, one ending July 31, and the other Dec. 31, 1895. In the first period the cost of coal and engine stores amounted, in round figures, to $2,500, and the station supplied 110,000 units. In the other period, coal and engine stores cost $6,000, and the station sold 366,000 units. The fixed expenses were alike in each period, and with the possible omission of some unimportant items, the running expenses were increased only $3,500 to increase the output of the station three and one-third times. The company's record show that of the total cost of operating the Brighton plant in 1895, less than one-sixth part was for actual running expenses. This is the ratio, with coal at $2.50 per ton, and Mr. Wright states that at the lower cost of coal in nearby towns, it would be less than one-ninth.

To come back to the application of the differential rates. After fixed expense has been determined, a ratable portion should be charged against each customer. A number of devices have been introduced to determine this ratable portion, further reference to which will be made later on. A sufficient rate is to be charged to cover both fixed and running expenses, until the customer has paid his share of fixed charges, after which the rate may be reduced so as to cover only the running expense incurred in supplying him, with, of course, a reasonable profit added. The plan does not necessarily reduce rates, except to such customers as are found profitable at reduced rates. Those who use a large quantity of current at different and irregular intervals, or whose demand is largely during the hours of the station's heavy load, would not be affected in that way, and by the use of some of the devices employed the most undesirable of such consumers would be subjected to a higher rate. The tariff may be arranged to suit varying local conditions, as in present methods.

The main object to the differential rate, and which, if accomplished, is obviously of the greatest importance to all central stations, is to induce longer hours for our product, and enable us to make special low rates to those who can find use for current during our slack hours. Our best customer is he who employs our capital the greatest number of hours per day, and our present rates are calculated to repulse, rather than encourage him. He now uses as little current as possible, and that usually at the time when it is most valuable to the station. The remainder of the time, when we would be making most profit, even at a low rate of charge, he "pieces out" with other kinds of light or power.

How plain it is to us when we pass a store in the evening and see in use only a few of the electric lights installed, that our revenue from that store is but a fraction of what it used to be, while our expenses go on the same as before. We feel this still more acutely when we see our service dispensed with entirely, and who of us can say that such sights are uncommon? Observation will prove that those most inclined to give up the service are meter customers running long hours, the very ones the station can least afford to lose.

In considering the adoption of differential rates, local conditions should be studied. If little or no demand can be found for current during the station's slack hours, even at a very low rate, the success of the system would be doubtful. If, on the other hand, a large demand could be worked up, the system would be highly profitable to the station and prove satisfactory to the public. The hours of effective operation would be increased, without any increase at all in fixed expenses. So large a part of the total cost is incurred in getting ready to supply current, and so little in actually supplying it after the machinery is started, that if central stations could be operated continuously up to their capacity, they could produce current so cheaply as to render competition out of the question. Of course, this is an ideal condition and will probably not be reached in the near future, if ever. It should be possible, however, to improve existing conditions to quite a large extent, and think we should not cease our efforts until we have found work for our stations that will materially increase their output through prolonged hours of operation. It seems clear that only by this means can we increase our business or even hold what we now have. If we can accomplish this, even to a moderate extent, it will so decrease the cost of production per unit that each of our present consumers could have more current at the same, or less, cost than now, and the remainder, even if sold at a very low rate, would bring sufficient revenue to largely increase the station's profits.

New business for our maximum load period will not accomplish this, as it entails an almost proportionate increase in fixed charges and does not extend the hours of operation. A system of rates giving the service, to customers who can use it outside of rush hours, at prices they can afford to pay, seems to be the most logical and feasible way. It may not appear an easy matter to find such customers, but if we first thoroughly inform ourselves how extremely low we could really afford to make the rates for a fair quantity of this class of business, the difficulty would not appear so great.

As to the devices intended to carry out the plan of differential rates, they are of several forms. The Wright demand indicator, as its name implies, records the greatest amount of current issued by a customer at any one time, the theory of its use being that such maximum demand on the station should regulate the portion of fixed expenses to be borne by the customer. It is assumed that the customer will use his maxmium demand a certain length of time each day, coincident with the maximum station load, and for that much of the total amount consumed he should pay a rate sufficient to cover fixed and running expenses. For the balance consumed, as shown by the usual recording meter, a lower rate is charged.

The double recording, or two-rate meter of the General Electric Company, appears to be their regular type with the addition of an extra set of dials and a clock mechanism. The clock is wound half-hourly by the action of current, and may be set so as to cause the meter to register on set of dials all the current consumed during any predetermined period, and on the other dials at all other hours. The theory of the use of this meter is that a customer's portion of the fixed expense should depend on the total amount of current he uses during the stattion's heavy load and a lower rate be charged him for all consumed at other times.

It is claimed that it enables the customer to use current liberally during all the hours of the station's light load. Although costing about $25 more than the simple recording meter, it possesses the good quality of performing the entire work without the aid of any other device. The customer can readily see how much each of high or low rate current he has used, and it is adapted to use on both direct and alternating systems. It has a mild tendency to prevent a heavy load during the station's rush hours, but not in the remaining hours when heavy consumption is rather desirable than objectionable.

The Oxley multiple rate meter controller, described in The Electrical Engineer of January 18, 1898, is a small electro-magnetic switch, to be installed at each point of consumption, and to be operated by a controlling switch in the central station. It may be used in connection with two recording meters, closing the circuit in one or the other at the will of the station operator by his manipulation of the station controller, or it may be used with a single recording meter, in which case it employs resistance to retard the speed of the meter during the low-rate period. The theory of its use is the same as that of the General Electric Company's two-rate meter, although I am informed it cannot be applied to alternating systems.

No attempt is made herein to give a technical or lengthy description of these devices, more than a brief mention of them, as means with which to carry out the differential rate system would be of no practical value in this place. If any of you wish to consider such a method of rates, you will want to study the various devices yourself, and decide upon their relative merits according to your local conditions.

The theory of differential rates may be applied in a modified orm with the use alone of the ordinary recording meter. Mr. Thayer, of Belle Plaine, Iowa, describes a plan in The Electrical Engineer of December 23, 1897, stating that he had then been using it for about a year, and that it had been highly satisfactory in the cases to which it is adapted. He appears to have adopted it largely in order to avoid straight flat rates, and does not refer to it as a differential rate plan, yet it appears to be somewhat on the same lines.

To a customer who installs more lamps than are needed for regular every day use he makes a fixed charge of 33 cents a month for each light used during the hours of the station's maximum load, and 5 cents besides for each kilowatt hour consumed. The 33 cents may be considered a charge for fixed expenses, incurred in getting ready to supply him with current, and the 5 cents per kilowatt hour a charge for running expenses after the machinery has started supplying him. Mr. Thayer states that this plan has proved a good one for a large class of his customers. It prevents any wide variation in the monthly bills, which is a frequent source of complaint from customers during the winter months. At the same time, the certain revenue of 33 cents per light will, in most cases, cover fixed expenses, and the 5 cents per kilowatt hour a reasonable return for the service. It does not make the charge burdensome to the customer burning long hours, the very one we should seek to get. The monthly charge for a light burned daily two hours would be 48 cents; four hours, 63 cents; eight hours, 93 cents, and twelve hours, $1.23. Thus, a customer using lights until 9 o'clock p.m. daily throughout the year would burn about two hours per day in the middle of the summer, making the cost per light 48 cents, and about five hours per day in the middle of the winter, costing about 70 cents, or an average the year round of a trifle less than 60 cents per month for each light.

A device such as the Wright demand indicator should be useful to stations selling current on the flat rate plan. Monthly rates could be made for each individual or class of customers, based on the greatest number of lights they would use at any one time, an additional charge to be made if that number should be exceeded. In case of dwelling houses, notice could be given the station when a large number of lights were to be used on special occasions, and the indicator could afterwards be reset. This would give the station knowledge of the frequency and extent that lights were used in excess of the agreed manner. It would check waste of current to a large extent, and reduce the maximum loads, especially in dwelling houses, where it is most serious, under the flat rate plan. The maximum station load would also be reduced, increasing its capacity and earning power, by making room for more customers with the same amount of machinery and coal consumption.

Any of the foregoing methods embody the differential rate theory in a greater or less degree, and should result in improved efficiency in the operation of our stations. If the system cannot be adopted in its entirety, some features of it might be applied that would meet local conditions more nearly than present methods, and work alike to the satisfaction of customers and the benefit of the central station.

To my mind, the question merits the careful study of every station operator, and is of so much importance that if we fail to give that study voluntarily, the trend of our business will force it on us sooner or later.

SPARKS.

Angus H. G. MacDonald, city electrician of Halifax, N.S., is dead.

The British Columbia Electrical Supply Co., of Rossland, B.C., is applying for incorporation.

The town of Liverpool, N. S., purposes installing an electric light plant, tenders for which have not yet been invited.

The city council of Montreal have decided to purchase a new boiler for the upper level pumping station.

The Dominion Coal Company, of Nova Scotia, propose doing away with horses for hauling purposes, and will utilize electricity entirely.

A shipment of 110 barrels of mica, valued at $6,000, was forwarded recently from the St. Anthony mines, near Ottawa, to W. H. Sills & Co., of Chicago.

The Grand Jury in the Criminal Assizes, Toronto, in their presentment, recommended that a boiler of larger capacity be purchased for heating the jail building.

The corporation of Peterboro', Ont., will ask the Ontario legislature for permission to acquire and develop water power on the Otonabee river, and to supply light, heat and power.

As a result of the boiler "sagging," the streets of Port Arthur, Ont., were recently without light for a short time. It is probable that another boiler will be added to the plant in the near future.

The War Eagle Mine expect to operate their works by electricity this month. Power will be furnished by the West Kootenay Power and Light Company, from their generating plant at Bonnington Falls.

The city of Halifax, N. S., invites tenders up to Wednesday, March 8th, for the supply of an electric light plant for lighting the streets and public buildings of the city. Particulars may be obtained from Mr. F. W. W. Doane, city engineer.

The Imperial Oil Company has absorbed the Bushnell Oil Company and the Eastern Oil Company, and a monopoly of the oil business of Canada is thus practically secured. The head offices will remain in Petrolia, while the Queen City Oil Company, Toronto, will continue to handle the Ontario business. Mr. C. J. Mills, the present manager of the Imperial Company for western Ontario, will be general inspector in Toronto.

J. B. Loyer, of New York, has purchased the Gold King mica mine at East Templeton, Que., and intends developing it.

The ratepayers of the village of Bradford, Ont., have voted down a by-law to raise $6,000 for installing an electric light plant.

A by-law to raise $67,750 by debentures for the purchase of the gas and electric light plants of a private company was defeated by the property owners of Galt, Ont., on January 9th.

The residents of Birchton, Ont., are endeavoring to make an arrangement with the Metropolitan Electrical Company, of Ottawa, to supply that village with electric light.

Mr. A. A. Dion, general superintendent of the Ottawa Electric Company, recently gave an interesting talk on "Electricity" before the Literary and Scientific Society of Ottawa.

The town council of Toronto Junction is considering the advisability of adopting an all-night service and of putting in additional plant to permit of supplying incandescent lighting.

A by-law has been approved of by the Lieutenant-Governor-in-council permitting the town of Fort William, Ont., to issue debentures to the amount of $11,000 for extending and improving the electric light plant.

The Fire, Water and Light Committee have recommended that the council of Rat Portage, Ont., take steps to purchase the electric light plant from the Citizens' Telephone & Light Company.

It is said that J. R. Booth will build a power house at the Chaudiere, and that an electric plant will be installed therein capable of operating all the machines in the shops at the deep cut and of supplying the required light.

The Stanstead, Que., Journal of recent date says: "The acetylene gas apparatus at the Marbleton Hotel exploded last Friday, setting fire to the hotel and destroying apparatus. Landlord Cote had a narrow escape, and others who assisted in extinguishing the flames were badly burned.

A deputation from Morrisburg, Ont., intervied the Dominion government recently with a view of obtaining water power from the Morrisburg canal to operate an electric plant for the town. A Lindsay deputation has asked for similar privileges from the Trent valley canal.

The Winnipeg Electric and Gas Light Co., now supplying the city with electric light, have been asked to submit a proposition for supplying 125 arc lights for another year. A motion that tenders be invited for electric lighting for a period of five years was voted down in council.

The annual meeting of the Canadian Rubber Company was held in Montreal last month, at which directors were elected as follows: A. Allan, president; H. McLennan, vice-president; H. M. Allan, W. H. Benyon, F. Scholes, J. B. Learmont, Andrew A. Allan, C. P. Smith and J. O. Gravel.

E. S. Jenison has completed the surveys for his power canal from Kakabeka Falls to Port Arthur. It is said that 100,000 horse power can be developed. The reservoir will be a large lake 4 miles long, covering an area of 4,000 acres, with a depth of 50 to 75 feet. Its surface will be 303 ft. above Lake Superior.

At the annual convention of the International Association of Fire and Police Superintendents and Municipal Electricians, to be held at Wilmington, Del., in September next, Mr. George F. MacDonald, of Ottawa, vice-president of the society, will read a paper on "Progress and Development of the Municipal Electric Interest of Canada."

A large driving pulley in the power house of the Ottawa Electric Railway Co. flew to pieces recently, badly wrecking the interior of the station. Michael Leroux, who was in charge, escaped uninjured. The wheel weighed 7,700 lbs., was 97 inches in diameter, and 52 inches across the face. The accident is said to have been caused by a flaw in the wheel.

The steamer Pro Patria of Halifax, is being equipped electrically, and for the purpose of lighting the steamer and operating searchlight, an order has been placed with the Canadian General Electric Company for the complete outfit, which will consist of one of their standard C. G. E. direct connected equipments, including engine, dynamo, switchboard, searchlight, and wiring complete.

Mr. Wells, manager of the St. Catharines Electric Light Co., has recently gained some notoriety. Mr. Quinn, proprietor of the Russell House, St. Catharines, changed the combination of his safe and locked it before making note of the numbers. He was informed by the safe manufacturers that the combination could not be worked out, it being a five-numbered one and impossible of solution. This fact becoming known to Mr. Wells, he volunteered to open the safe, and in two hours his efforts were rewarded by the combination working out.

A conference of manufacturers of carbons was held in Chicago on January 12th, as a result of which a carbon trust may be formed, with a capital of $10,000,000. It is said that the following companies in the United States are in the combine: The National Carbon Company, Cleveland, Ohio; Brush Carbon Works; Standard Carbon Works; Crouse & Tremaine Carbon Company, Fostoria, Ohio; Thomson-Houston Carbon Company, Freemont, O.; Faraday Carbon Company, Jeannette, Pa.; Phoenix Carbon Company, St. Louis; American Carbon Company, Noblesville, Ind.; Washington Carbon Company, Pittsburg; Partridge Carbon Company, Sandusky, Ohio. It is further stated that the syndicate will own a half interest in the Ottawa Porcelain & Carbon Company, at Ottawa, which controls the carbon industry in Canada.

SPARKS.

The electric light plant for the new Victoria hospital at London, Ont., has not yet been purchased.

The Canadian General Electric Company, Toronto, are again to the front with one of the prettiest lithographic calendars which has yet come to our notice.

The Canadian General Electric Company have recently sold a 50 light dynamo to be installed in the premises of one of their customers at Edmonton, N. W. T.

The city council of Hull, Que., received tenders up to February 6th, for the supply of an electric light plant. The tenders will be opened by the council on the 17th instant.

The process used by the National Electrolytic Co., of Niagara Falls, N. Y., for the production of chlorate of potash, is the invention of Mr. T. Gibbs, of Buckingham, Que. The details of the process are kept a secret.

The Hawthorn Woolen Mills Company, of Carleton Place, Ontario, are increasing their lighting plant, and have placed their order with The Royal Electric Company for one of their 25 k. w. bi-polar direct current generators.

An arrangement was consummated on January 20th for the sale of the Edison Electrical Illuminating Company, of New York, to the New York Gas and Electric Light, Heat and Power Company. The issue of bonds will be limited to $21,000,000.

The Canadian General Electric Company have recently sold to Messrs. Evans & Hastings, printers, Vancouver, B. C., a 6 kilowatt Edison dynamo, and to Braid & Company, of same city, a 10 h.p. motor for use in their spice mills.

The E. T. Wright Company, of Hamilton, are having installed in their factory a 50 h.p. S.K.C. motor to drive their machinery. The power by which this motor is driven is taken from the Cataract Power Company's wires. This is the tenth installation from their service into factories in Hamilton up to date.

The directors' statement presented at the annual meeting of shareholders of the Toronto Electric Light Company, held a few days ago, was of a satisfactory character. It showed the payment of four quarterly dividends at the rate of 7 per cent. per annum, with a small balance carried forward to the credit of profit and loss account.

The Montreal Water & Power Company, of Montreal, are installing in their pumping station a 400 h.p. S.K.C. two-phase motor, operating at 180 r.p.m. This motor is intended to operate the water works pumps, and will be driven by current generated at Chambly Rapids, a distance of sixteen miles away. This is one of the largest single motor installations in Canada.

The Royal Electric Company have received an additional order from the Hamilton Electric Light & Power Company for a 500 h.p. S.K.C. two-phase synchronous motor, which will operate a shaft driving their arc circuits and street railway power circuits. This is an addition to the 350 h.p. motors noted in these columns in our last issue. The first of the two mentioned has been in operation for some time with perfect success.

Mr. M. Hutichson, superintendent of the municipal electric light plant at Victoria, B.C., refers in his annual report to the breaking of the terminal wires in the armatures, the main cause being excessive floor vibration. To remedy the breaking off of lamp loops during windy weather, he recommends that flexible safety loops be placed on all lamps in exposed positions. The total number of lamps now in use is 230, and the annual cost per lamp per annum, exclusive of interest and sinking fund, is given as $53.

The Metropolitan Electrical Company, of Ottawa, are about to proceed with the development of their water power at Britannia, Mr. George A. Wanless, the secretary-treasurer, having invited tenders for the excavation of canal and wheel pits, and the construction of dams, cofferdams, cribwork, flumes, embankments, roads, masonry, concrete work, etc. The company will probably erect a transformer station near the Maria street bridge, and will transmit the current at a pressure of 10,000 volts. The entire plant will cost probably $250,000.

The corporation of Barrie, Ont., has engaged Mr. Roderick J. Parke, E.E., of Toronto, for a period of one year, to take charge of the re-arranging and re-construction of the electrical lighting system recently purchased from the Barrie Electric Light Company, and to supervise its operation. About $15,000 will be expended in additions and improvements; among the additions will be a 2,500 light alternator, an 80 light arc generator, 65 arc lamps for street lighting, 125 h.p. engine, and an extension to the present station building. The street distribution lines will be replaced by modern and efficient construction. A 15 station fire alarm system will also be installed at an early date.

The Canadian General Electric Company report the following recent sales: To the Comstock Concentrator, of Silverton, B. C., a 25 light Edison dynamo, to be used in lighting their premises; to the Athabasca Gold Mining Company, of Nelson, B. C., a 100 light Edison dynamo, to be used in lighting their buildings at the mine; to the Savoy Theatre at Vancouver, B. C., a 250 light incandescent lighting dynamo, of their multipolar slow speed type; to the Scottish Colonial Mining & Milling Company, of Three Forks, B. C., a 100 light 16 c.p. incandescent dynamo for lighting their buildings at the mine; to Messrs. McKenzie Bros., of Victoria, B. C., a 6 kilowatt Edison motor; to the B. C. Electric Railway Company, to be used in driving the blower apparatus in their power house, a 12 kilowatt Edison motor; to Messrs. Hoffmeister Bros., of Vancouver, B. C., a 25 light incandescent lighting dynamo; to J. C. Woodrow, of Vancouver, B. C., a 3 kilowatt Edison motor; to Messrs. Hinton & Company, of Vancouver, B. C., to be installed on a steamer navigating Lake Bennett, a 25 light incandescent dynamo

The Lambton Oil Company, Limited, of Sarnia, Ont., has bee incorporated, with a capital stock of $20,000.

At the next open meeting of Hamilton No. 2, C.A.S.E., Mr. Wm. Turbayne, E.E., will read a paper on "Arc Lighting."

The Westinghouse Electric Company, of Pittsburg, Pa., is reported to have placed orders for 60 boilers with the Babcock & Wilcox Company, of London, Eng.

The Guelph Light & Power Co. have recently purchased a new 1000 light single phase alternator from the Canadian General Electric Company, together with marble switchboard panels for the control of two machines.

The town of Essex is to have an incandescent system of electric lighting. Mr. C. E. Naylor, of that place, having undertaken the operation of the system, has purchased from the Canadian General Electric Co. a 750 light machine for the purpose.

Messrs Corley & Collins, of Mount Forest, have experienced such an increased demand for lighting during the past two months that they were compelled to increase their facilities, and have purchased from the Canadian General Electric Co., one of their standard 1000 light single phase alternators, with marble panel switchboard and exciter, for the purpose of meeting these requirements.

The town of Port Arthur, Ont., has been operating its street railway, which extends from Port Arthur to Fort William, at a loss, and will likely adopt a new schedule of fares. The present rates are: Cash fares, 5 cents; blue tickets, 6 for 25 cents; morning and evening tickets, 8 for 25 cents; school children, 10 for 25 cents. For one fare passengers are permitted to ride from end to end of the line—over seven miles.

Andrew Holland, of Ottawa, has prepared an estimate of the various water powers in the Ottawa valley. His calculation is as follows: Ottawa river, 664,000 h.p.; Rideau river, 1,300 h.p.; Mississippi river, 14,700 h.p.; Madawaska river, 20,600 h.p.; Bonnechere river, 3,400 h.p.; Petite Nation, 2,000 h.p.; Blanche river, 2,000 h.p.; Lievres river, 98,450 h.p.; Little Blanche, 300 h.p.; Quyon river, 100 h.p.; Coulonge river, 27,600 h.p.; Black river, 24,000 h.p.; Gatineau river, 31,675 h.p.; total, 890,225 h.p.

A copy of the prospectus issued by the Bedford Electric Company, of Halifax, N.S., is to hand. The company, which is capitalized at $250,000, proposes to install an electric plant at St. Margaret's Bay, to transmit light and power to Halifax and other points in the vicinity, and to furnish power for the operation of an extensive pulp mill to be erected. The transmission line will be 18 miles in length, and the pipe line from the power house to the dam about 4,000 feet in length. It is also proposed to operate an electric tramway to Halifax. Mr. M. M, Keefe, of Halifax, is president of the company, and Mr. A. E. Soulis, manager and secretary.

The Canadian General Electric Company have been awarded by the Department of Railways and Canals, the contract for the erection of a power house, and the complete equipment of the Soulanges canal with electrical apparatus, for operating the locks, by means of electric motors. The entire canal, covering a distance of 14 miles, will be illuminated by arc lamps. Owing to the success met with, by the Department, in the operation of electricity at the canal at Sault Ste Marie, Ont., as applied to the locks, they decided to make a more extensive application of the use of electricty, in the illumination and electrical operation of the locks of the Soulanges Canal.

A 6-inch belt, travelling through 4,000 feet of space per minute, will run machinery equal to a 24-inch belt only running at the rate of 1,000 feet per minute. A belt should never be laced too tight, for the belt will be hard upon itself. The motion that is produced between the pulley and the belt is maintained by friction. Belts laced too tight will cause friction to such an extent that it will consume all the power of engine. Under a given load, it is wonderful to see how much power of resistance there is in a good belt. It can be strained for months, and after a short period of rest will return to its original strength and length.

THE FIRST INTERNATIONAL ELECTRIC RAILWAY.

Ottawa, January 28th, 1899.

Editor Canadian Electrical News:

Dear Sir,—In your issue for January, 1899, you state that the Niagara Falls Park and River Railway has the honor of operating the first international electric railway between the United States and Canada. This road began operations in 1898, the first car crossing on July 1st of that year.

There is another road which may fairly claim to be the pioneer. The Calais & St. Stephen Electric Railway has the right to the honor. The first car crossed the bridge over the St. Croix river (dividing Maine and New Brunswick), from Calais to Milltown, in July, 1894, and the first car over the bridge between Calais and the town of St. Stephen crossed in June, 1895. This would give the Niagara Falls Park & River Railway third place.

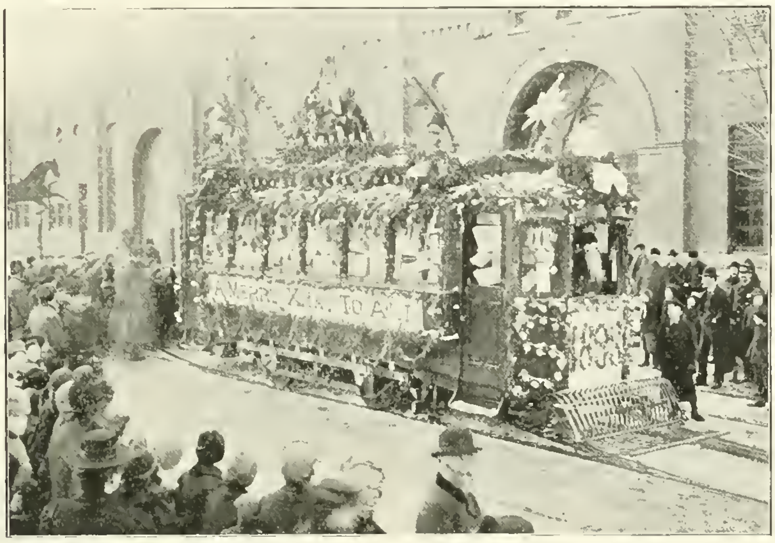
Yours truly,
George Johnson.

ELECTRIC RAILWAY DEPARTMENT.

A CHRISTMAS TROLLEY CAR.

The children of Ottawa appeared on the streets of that city in large numbers on Christmas eve last, to await the arrival of the Santa Claus car which has become such a welcome annual visitor, and which is responsible for gladdening many a young heart.

For some days before the event Mr. Soper, in whose mind the idea first originated, caused letters, under the signature of "Santa Claus," to appear in the Ottawa papers, to the effect that the writer (Santa) would visit Ottawa and go through the streets of the city mounted on top of an electric car, accompanied by a suite of brownies, and that oranges would be distributed to the children en route. The letter excited intense interest among the children, and during the progress of the car the principal streets were crowded. Santa Claus used a tally-ho horn to give the call, and the brownies created a great deal of amusement by their grotesque antics. Some 5,000 oranges were distributed. The car was not in any way an advertisement, but was simply the outcome of a desire on the part of Mr. Soper to afford amusement and pleasure to the youngsters of Ottawa.


Christmas Car—Ottawa Electric Railway Company.

A splendid illustration of the car, and portraits of the brownies, are presented on this page.

ANNUAL MEETINGS OF ELECTRIC RAILWAY COMPANIES.

THE TORONTO RAILWAY COMPANY.

The annual meeting of the shareholders of the Toronto Railway Company was held last month, at which the board of directors was re-elected. The report presented showed net profits for the year 1898 of $404,738, out of which $240,000 had been paid in dividends and $64,000 in mileage allowance, leaving a balance of $100,738. The receipts from the operation of the Sunday car service showed a steady increase, being $367.24 per Sunday greater than in 1897. During the year 30 closed and 20 open motor cars had been added to the rolling stock, and 40 additional open cars are now being constructed. There were also purchased during the year 70 electric motors and 50 improved steel trucks.

The following statistical statement, showing a comparison of the business and earnings of the company since its purchase of the franchise in 1892, was presented :

Gross earnings—1892, $820,098.49 ; 1893, $900,232.59; 1894, $958,370.74; 1895, $992,800.88; 1896, $997,273.20; 1897, $1,077,611.53; 1898, $1,210,618.24.

Operating expenses — 1892, $590,333.26 ; 1893, $637,579.15 ; 1894, $517,707.53 ; 1895, $489,914.76 ; 1896, $507,760.31 ; 1897, $525,801.25 ; 1898, $578,857.26.

Net earnings—1892, $229,765.23 ; 1893, $362,635.44 ; 1894, $440,663.21 ; 1895, $502,886.01 ; 1896, $489,512.97 ; 1897, $551,811.28 ; 1898, $631,700.98.

Percentage of operating expenses to earnings in 1892, 71.9 ; 1893, 59.07 ; 1894, 54 ; 1895, 49.3 ; 1896, 50.9; 1897, 48.8 ; 1898, 47.4.

Transfers — 1892, 5,592,708 ; 1893, 8,477,147 ; 1894, 7,438,171 ; 1895, 7,257,572 ; 1896, 7,354,895 ; 1897, 8,199,022 ; 1898, 9,287,239.

Passengers carried 1892, 19,122,022 ; 1893, 21,215,010; 1894, 22,609,338; 1895, 23,353,228 ; 1896, 23,537,911 ; 1897, 25,271,314 ; 1898, 28,710,338.

OTTAWA ELECTRIC RAILWAY COMPANY.

At the annual meeting of the Ottawa Electric Railway Company, held recently, the annual report submitted showed the gross earnings for 1898 to be $231,802, an increase of $8,000 over the preceding year. During the year four quarterly dividends of two per cent. each were paid. Six open and six closed cars were added to the rolling stock of the company. The report mentions that the outlook for a large development of both passenger and freight traffic is very promising. The number of passengers carried was 5,200,000, while five years ago the number was only 2,394,000.

The following board of directors was elected : T. Ahearn, president and manager ; J. W. McRae, vice-president ; Warren Y. Soper, G. P. Brophy, Thos. Workman, Alex. Lumsden, M.P.P., and Peter Whelan.

HAMILTON, GRIMSBY AND BEAMSVILLE ELECTRIC RAILWAY COMPANY.

At the annual meeting of the Hamilton, Grimsby and Beamsville Electric Railway Company, held in Hamilton a fortnight ago, the president, Mr. C. J. Myles, presided. The annual statement presented by Mr. Nelles, manager and secretary, showed the receipts during the year to have been $42,736.42, an increase of $735 over 1897. The net earnings were $13,981.11. The passenger business during the year amounted to $34,060.15 ; freight, $5,521.66, and express, $1,618.13. President Myles estimated that the company lost about $1,000 owing to the big snowstorm in December. A dividend of 5 per cent. was declared. The directors were re-elected as follows : Messrs. C. J. Myles, president ; W. J. Harris, vice-president ; R. S. Martin, treasurer ; L. Bauer, R. Ramsay, A. H. Myles, J. Gage. Mr. A. J. Nelles was reappointed treasurer and manager.

Christmas Car—The Brownies.

SPARKS.

Mr. B. B. Osler, Q.C., has been elected president and Mr. Mark Thomas manager of the Hamilton and Dundas Railway.

The Hamilton Street Railway Company have elected Mr. Edward Martin, Q.C., as president, and Mr. John A. Bruce as vice-president.

A bill respecting the inspection of steam boilers and providing for the security of the lives of those working around steam engines has received a second reading in the British Columbia Legislature.

The directors of the Hamilton, Grimsby and Beamsville Railway Company have been asked by the residents of Vineland to extend their road to that place, five miles distant from Beamsville.

The Niagara Falls, Wesley Park and Clifton Tramway Company have made a proposition to the village councils to convert the horse car line between Niagara Falls and Niagara Falls South into an electric system.

Several Canadian street railway magnates, including Mr. James Ross and Mr. R. B. Angus, have been on a tour of inspection in the United States, with a view of obtaining pointers looking to the improvement of the street railway systems in Canada.

The Montreal Street Railway Company have decided to concentrate the whole of their constructive work at the Hochelaga shops. In the spring the company will build a large brass foundry for the manufacture of brasses and a large iron foundry for the iron work required in connection with their vehicies, an important part of this being the car wheels, which they intend to manufacture for themselves in future.

A new agreement has been entered into between the town council of Toronto Junction and the Toronto Suburban Electric Railway Company. One privilege granted the company is the extension of the franchise for 23 years from September 1st last. The company agrees to extend its lines to Cooksville or Woodbridge in two years, and to reach both places before the expiration of the present franchise.

A statement has been compiled showing the yearly earnings of the street railways in Montreal and Toronto for the years 1897 and 1898. In 1897 the Montreal street railway earned $1,397,383 and in 1897 $1,526,457. The respective earnings of the Toronto street railway were $1,048,273 and $1,187,622.

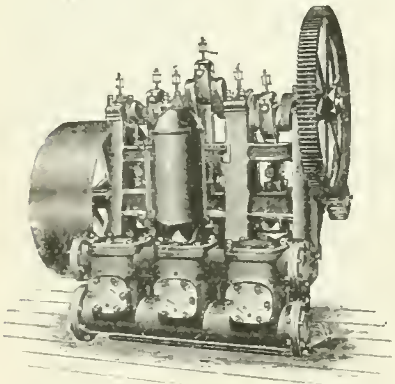
The C.P.R. Company several years ago discontinued running steam cars between Aylmer and Hull, Que., and gave over the road to the Hull-Aylmer Railway Company. Within the past month this latter company have purchased the road, paying therefor a sum in the neighborhood of $100,000.

The Galt, Preston and Hespeler Street Railway Company held its seventh annual meeting on January 31st. The business of the year was ahead of the previous one in both freight and passenger departments. Officers were elected as follows: Hugh McCulloch, president; Martin Todd, vice-president; W. H. Lutz, secretary-treasurer.

For the last three months of 1898 the gross earnings of the Quebec, Montmorency & Charlevoix Railway Company's system were over $79,000 and the operating expenses less than $34,000. After deducting one-fourth of the cost of removing snow in the winter, which is estimated at $12,000, the net revenue for the three months was over $42,000.

At the annual meeting of the Hamilton Radial Electric Railway Company held a few days ago, the reports presented were eminently satisfactory. The old board of directors was re-elected as follows: A. Turner, president; W. A. Wood, vice-president; John, Moodie, sr., treasurer; Stuart E. Malloch, secretary; James Dixon, Adam Zimmerman, John Moodie, jr.

The annual meeting of the London Street Railway Company was held on January 12th. The gross earnings for the year were stated to be $12,000 more than in 1897. The number of passengers carried was 2,841,568, and the number of miles travelled 1,074,302. The total gross earnings were $113,811.73. Mr. H. A. Everett was re-elected president, and Mr. T. H. Smallman was chosen vice-president in the place of Mr. E. W. Moore. Mr. Carr retains his position as manager.



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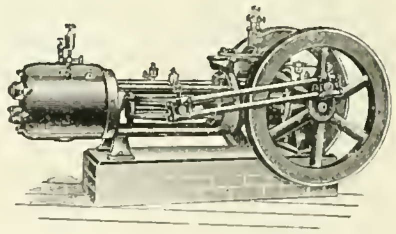

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At the request of the promoters of the proposed electric railway from Thamsville to Rondeau, an estimate of the cost of construction has been made by Mr. G. S. Johnson, general manager of the Consolidated Street Railway Company, of Grand Rapids, Mich. The length of the proposed road is 25 miles, and Mr. Johnson places its total cost at $257,968. Of this the power house, generators, boilers, etc., represent $50,000, and the cars, wire, equipment, etc., $125,000. To pay 5 per cent. on an outlay of $250,000 the road would have to earn $12,500 per year over running expenses.

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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. IX. MARCH, 1899 No. 3.

THE ELECTRIC SIREN.

WHAT promises to be an instance of the practical adaptation of a long neglected possibility is the development of the principle of an electrically vibrated diaphragm, as found in apparatus recently elaborated in the hands of Mr. A. G. Trudeau, of Ottawa. The subject is one of such interest from an engineering point of view that some pains have been taken to obtain the information concerning it that is now here presented. The massive apparatus to be seen in Mr. Trudeau's workshops is the outcome of a long line of patient and persevering experimentation, and bears on the face of it and in its hugeness strong evidence of the inventor's confidence in the utility of what he had in view.

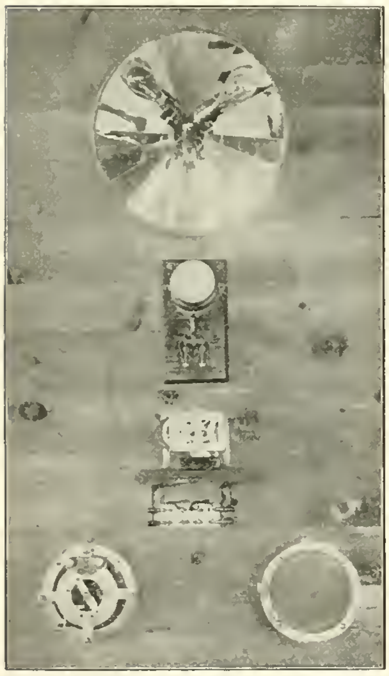

FIG. 1.—CLOCK MECHANISM AND SWITCHES, WITH GROUP OF INCANDESCENT LAMPS AND REFLECTOR.

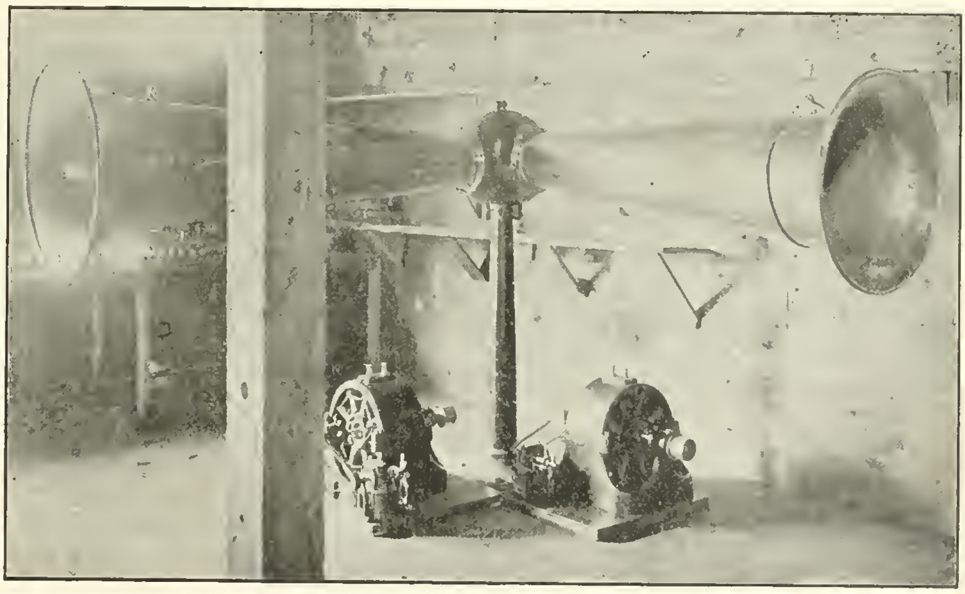

FIG. 2.—ELECTRIC COAST SIREN.

PRINCIPLE OF THE CONTRIVANCE.

Every user of the telephone is familiar with the behaviour of the 'phone if it happens to be "off the hook" and the distant ringer is put in motion. The diaphragm of the 'phone is subjected to a series of alternating current impulses, and manifests the effect of these by giving out a clattering noise not unlike the automatic electric buzzers sometimes used in place of the ordinary vibratory call bell. This observed behaviour of the 'phone under such conditions has been obviously enough suggestive of the construction of a call system comprising just such parts, but in practice the idea has not taken hold hitherto, perhaps because of the different elements going to make up the system not having been given proper shape to fill the requirements.

Mr. Trudeau conceived at the outset that the vibratory alternate current of the electric light might be adapted for the purpose in place of the magneto ringer, and this conception led to the construction of instruments actuable in a commensurate way by any such extraordinarily heavy currents as might be had from such a source. Going further in the same direction, he supplied the sound products with current from a special alternating dynamo, the number of whose current pulsations per second can be altered at will by an increase or decrease of its speed, or otherwise, and thus achieved a variable action in the sound producer, corresponding to the variation of note in a complex steam whistle or siren—whence the descriptive name for it with which this article is headed.

DETAILS OF CONSTRUCTION.

In furtherance of the foregoing comprehensive explanation of the character of the invention, the following details of the apparatus as now elaborated are given for the benefit of those of the readers of the ELECTRICAL NEWS interested in any new and unlooked for development of this kind. The outfit shown in the accompanying illustrations comprises what is needful for a lighthouse, with electric light and siren combined. In Fig. 1 a group of three powerful incandescent lamps, with reflector, is shown above the clock-work and switches. The number of these lamps is obviously referable to the volume of current supplied, and may be replaced by an arc for the operation of a search-light if desired. Immediately beneath is shown an automatic time-switch, by which the lights and the siren (the latter shown in Fig. 2) may be operated alternately or simultaneously at given periods as arranged for. The clock-work may be an eight-day movement, requiring winding but once a week, and therewith the lights and siren might be operated automatically between, say, 5 p.m. and 8 a.m. daily, or at any other hours as predetermined. This clock-work, by which the signalling devices are operated, has two baths of mercury and two contact makers that dip into them and so close the respective circuits. As now arranged in the workshop, the siren is sounded for 20 seconds, and then the light is turned on for the remaining 40 seconds of each minute; the contact wheel makes but one revolution per minute, and so renders the wear and tear inappreciable and the movement durable and reliable. A rotating brush commutator might, of course, be used instead of this mercury contact but that the make and break spark would in time eat away the commutator segments and prove troublesome.

Beneath the lamps and switches there are shown front and back views of the vibrator or sound producer. It is very substantially constructed, having a steel frame, which is first coppered and then nickel plated so as to avoid rust and corrosion. The diaphragm is said to be of a specially prepared material and of magnetizable character, a suggested modification being one of bell metal or other non-magnetic material provided with small projections of iron to serve as armatures for the actuating electro-magnets, and it is secured in the frame by an annular clamp, somewhat after the fashion of a drum head. A screw device by which the amplitude of the vibrations of this diaphragm or drum head is to a certain extent regulated, is mounted opposite the centre in a cross piece at the back. A group of electro-magnets, made up of laminated iron cores wound in the ordinary way, is fixed in the frame and hidden by the broad and smaller annular ring shown in the left-hand (back) view, and thoroughly covered with insulating compound, and covered with rubber to shut out all moisture.

In Fig. 2 is shown the fog-horn proper, in one of the many forms that is being given to the device, and to be designated the "coast siren." It comprises two huge funnels made of ¼ inch copper and finished at each end in brass. Each of the funnels project 6 feet 6 inches from the stand, at right angles to each other. In each of these funnels or horns a vibrator or sound producer is placed, the object being to use them alternately or simultaneously as may be desired. The stand is of cast-iron and of very substantial form, 6 feet high, surmounted by a large hollow cast iron sphere, from which the horns project. This sphere is divided into two, the back portion opening on a strong hinge, enabling the light keeper to clean the instruments or make any necessary adjustments or repairs. The vibrator is self-contained and may be taken out and replaced by another in a moment, so there need be no time lost in event of a vibrator becoming broken or otherwise disordered.

Below the siren the source of the operating and lighting current is shown. This part of the plant comprises two alternating current dynamos with separate and interchangeable field exciters. Only one of these alternators is to be used at a time, however, the second being provided as a precaution against an accidental break-down. They have a capacity of 3½ h.p., are of the multipolar type, and were specially designed by Mr. Trudeau for the purpose, and they occupy each a floor space of 18 inches square and are 18 inches high. The field exciters were also specially designed, and occupy a floor space of but 6 x 8 inches, and are 8 inches high. All the work done on the different parts of the outfit is of the highest order and everything in its make-up has been designed and manufactured by Mr. Trudeau or under his immediate supervision in his shop.

The engines to be associated with the electrical plant are not shown in the illustrations. It is proposed to use a Gasoline type that can be set to work in one or two minutes. The power required to operate the siren and the light alternately is put down as 1 h.p. and is estimated to cost 15 cents; or, in cases where the maximum capacity of the plant (3½ horse power) is to be utilized —as for instance when a search-light is used—3½ x 15 = about 50 cents for a ten hours' run.

The complete installation, including the spare set of apparatus and dual engines, may be placed in a lighthouse room less than 8 feet square, and there being no cumbersome boilers, air compressors, etc., understood to be indispensable to other systems for a like purpose, the whole is calculated to be placed in position at a comparatively trifling cost.

OTHER APPLICATIONS.

Obviously, the apparatus in the form described in the foregoing has been designed to demonstrate the practicability of operating fog-alarms in places ordinarily inaccessible for steam plants, and where bell-buoys and hydraulic whistling-buoys are inadequate because of their comparatively feeble sounds being drowned in the noise of waters on neighboring shoals and wave-beaten head-lands. For the development of his invention, with this important object in view, too much credit cannot be given Mr. Trudeau, and it is to be hoped his undertaking will meet with a well-merited success.

Since it is immaterial how far the source of the actuating current is from the signalling instrument, or whereabouts in the circuit the controlling devices are located, the whole contrivance affords an ideal flexibility that can be approached by no other known means that has been devised for marine signalling purposes, and its adaptation to harbor-buoys connected by cable is only a matter of detail.

The minor applications for the device in its smaller forms, whether in combination with electric lighting currents or independent sources of current, are manifold and various—fire and burglar alarms for instance, or hotel and railway station gongs, police and cab calls, etc., all too patent to call for more than passing mention. Upon the whole, this interesting development of a neglected feature of every-day electrical operation seems well worth the extended notice that has herein to it been accorded.

D. H. KEELEY, M.I.E.E.

OTTAWA, 8th March, 1899.

At Tilbury, Ont., there is a municipal electric plant, which is in charge of Mr. J. H. Ward. We are advised that 400 lights are now wired up, while the capacity of the machines is only 500 lights. It is probable that the system will be changed to alternating, and a new 750-light machine installed. Some of the customers wanting lights are not within economical reach of the direct current system. One of the dynamos now doing service will likely be used for furnishing power for small motors, fans, etc., for which there is some demand.

THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

The annual meeting of the Lachine Rapids Hydraulic and Land Company, Limited, was held in Montreal on February 17th last. After the reading of the report explanations were made by the managing director as to the cause of the trouble during the past winter in connection with the lighting. He stated that it was owing to various causes, such as the extreme severity of the weather, which caused a block of ice below the tail-race—a phenomenon which had not occurred for forty-five years previously. He suggested remedies which he said would unquestionably overcome any such difficulties in future. It is understood that the tail-race dam will be extended and that other slight alterations will be made at the head race for the purpose of preventing interference from ice. Additional dynamos will likely be installed at once.

The report of the directors stated that, notwithstanding the difficulties incidental to the inauguration of all new enterprises, the business of the company during 1898 had been very satisfactory, and the general outlook for the future was bright.

The financial statement presented was as follows:

Gross earnings for the year ending December 31st, 1898		$118,121 23
Discounts allowed		19,824 53
Net earnings		98,296 70
Add interest on bank account and stock calls, and discounts on cash purchases		3,991 12
Gross revenue for the year		102,287 82
Operating expenses, including general expense, lamp renewals, commissions, pole rent, placing meters, testing meters, painting poles	$45,098 33	
Rent, insurance and taxes	3,897 73	49,996 06
Leaving a gross profit of		$52,291 76
From which has been charged for interest on bonds.		19,530 47
Leaving a net profit of		$32,761 29

equivalent to almost 3 p. c. on the paid up capital.

From the report the following particulars are obtained: During the year additions to the plant were made which cost $206,866. The company have constructed in Montreal and vicinity 175 miles of wire, and have also placed 4,700 cross arms. This work consists of three phase lines for power and light on the principal streets of Montreal, and a large number of single phase circuits in localities where lighting only is used. An arc system was constructed for the C.P.R. at Outremont, and a permanent switch-board at the power house.

The total number of incandescent lamps on the company's circuit is 40,135. Of the above 35,335 incandescent lamps or their equivalent are on meter, and 4,800 on flat rate. This is exclusive of lights furnished by the Imperial Electric Company, who receive the necessary current from the Lachine Company. The total number of alternating arc lamps not on meter is 309. The company have 36 motors installed, with a total capacity of 924 h.p. Last year there were added over 15,000 incandescent lamps, while the number of arc lights increased from 54 to 109. The increase in flat rate customers for incandescent lighting was from 227 to 343, and their power service increased from nothing to 924 h.p.

Attention is drawn to the fact that the principal profit from the plant already installed is derived chiefly from the output of a few hours' lighting out of the twenty-four, that although lamps are connected and current is on, the customers only use the power during a short space of time, while the operating expenses of the company remain the same as though their power were being used and paid for during the whole period. They could afford to dispose of power at a very low rate if customers could be found who would be prepared to use it at other times than the hours above referred to.

The directors point out with much satisfaction that the company has been able during its first year of operation to pay not only the interest on its bonds, but all its operating expenses, and earn the handsome profits of nearly $33,000.

NERNST'S ELECTRIC LIGHT.

Prof. Walter Nernst, of the University of Gottingen, Germany, is the inventor of a new method of lighting by electricity, which is briefly described in the following abstract from a paper read by Mr. James Swinborne before the Society of Arts, London, England, on February 8th last:

Nernst's, like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on the temperature. The efficiency of an incandescent lamp, for instance, depends on the temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature, especially as, in addition to its low specific resistance, the filament has to be long and slender, and thus weak. Nernst, therefore, chose a material that would stand higher temperatures than carbon, and his material has the incidental advantage that its specific resistance is so high that strong rods can be used for high pressures instead of thin filaments. The most refractory materials so far used in lighting are zirconia, which has been used to replace lime in the limelight, and the oxides or so-called rare earths in the Welsbach mantles. I am aware, of course, that many people suppose that the Welsbach mantle is not very hot, treating it as if it were at a temperature, for instance, below the melting point of platinum. The light emitted is supposed to be due to some special power of selective emission due to the oxides employed. I have had a good deal to do with incandescent gas mantles, and I find no reason to suppose there is any magic effect of this sort going on. The part of the flame where the mantles hang fuses platinum wire easily, and very few materials can stand the temperature without fusing or volatilizing. Lime and many other oxides volatilize slowly from the mantles. I do not mean that the mantles are above the boiling point of lime; I have some idea of its melting point, as I have made a few pounds of melted lime, and run it out on the floor to look at it. The Welsbach mantles, which are now chiefly thoria, are at a temperature near their softening point, and in the making are raised to a temperature at which they begin to soften.

Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot; Nernst, therefore, heats the rods to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. This means that he can take the most refractory bodies supplied by the whole range of chemical research, and can heat them to a temperature short of their softening point, and can thus get an efficiency unknown to workers on the incandescent lamp. Such efficiency also means whiteness of light, so long as the efficiency is not too high. Thus the crater of the arc being at a temperature of boiling carbon, gives a light that is unpleasantly blue. The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod, with its two wires, is then mounted in a holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electrolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause, by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistance of the lamp. The consumption, including the resistance, is 1.5 watts per candle for large lamps, and 1.6 for small lights or low pressures. In small or low pressure lamps the loss of heat at the ends is larger in proportion.

In all probability an electric light plant will be installed in the new city hall in Toronto, for the purpose of lighting the building.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal.

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

The Overcrowding of Street Cars.

THE bill which was recently introduced in the Ontario Legislature by Mr. Crawford, M.P.P., to regulate the overcrowding of street cars is, to our mind, one of the most unreasonable measures which has yet been compiled. Applying only to cities with a population exceeding one hundred thousand, it is applicable exclusively to Toronto. Clause one provides that every passenger on a street car shall be entitled to a seat, while the third clause states that no person shall be refused the right to admission in any car provided there is reasonable standing room for such passenger. A passenger unable to secure a seat is to demand and receive from the conductor a ticket entitling him to a seat in any car on the same route during the same hours of any other day, or at his option he may tear his ticket into two parts and use one part for that trip, the other part to be good for a standing trip at any future time when the cars shall be so overcrowded that he shall be unable to obtain a seat. Such a law would be unworkable, and unfair to the companies operating street railways, who are given no protection from unscrupulous persons, who would seize every opportunity of boarding a car whose seating accommodation was already exhausted, notwithstanding that other cars in which seats could be had might be available. In large cities, upon the occasion of the holding of exhibitions, public meetings, and other events to which the public are attracted, the people gather in such numbers that no reasonable street car service could provide the necessary accommodation to the satisfaction of all. Another illustration will show the absurdity of the bill. A passenger might board a car the seats of which were occupied, pay his half fare to the conductor, and at the next stopping point—perhaps not two hundred yards distant—one of the passengers might alight, thus giving him a seat for almost his entire journey. In these instances, Mr. Crawford's bill, if passed by the Legislature, would be the cause of a serious injustice to the railway companies.

The Nernst Method of Electric Lighting.

THE information to hand respecting the new departure in incandescent lighting (Nernst's invention) is scarcely complete enough to warrant a definite opinion. It looks as though it would create a new departure in incandescent lighting on similar lines to the Welsbach improvement in gas business. The Welsbach was considered one of the greatest advances in gas illumination ever brought forward. Experience of its continued use, however, has not quite justified the sanguine expectations of its promoters. The Nernst lamp may be a new departure that may practically revolutionize electric lighting, or it may develop defects and unforeseen drawbacks that may keep it from becoming a serious competitor with the present system of vacuum lamps. An automatic arrangement to heat the rod must be, to a certain extent, complicated and liable to get out of order and unsuitable for small lamps. It may be that for store lighting, such places as factories, railroad stations and so on, the system would be eminently suitable, while for high class lighting, such as for residence purposes and decorative effects, the vacuum lamp would lend itself with much greater adaptability. The cost of this lighting is not so excessive at the present time that convenience and appearance may be sacrificed for the sake of extreme economy. At present something must be allowed for the enthusiastic optimism with which a new departure like this is apt to be received, but notwithstanding, later developments may show that a distinct advance has been made in the commercial adaptability of the electric light.

Municipalities and Lighting Companies.

THE treatment accorded to electric lighting companies in Germany appears to closely correspond to that which Canadian private lighting companies in many instances receive at the hands of the municipal councils. The City Council of Berlin proposed to give a contract to the electrical companies for the supply of electricity for a period of fifteen years, provision being made that the municipality should participate in the profits. Strong pressure was brought to bear by the social democrats to compel the Council to assume entire control of the electric lighting. This demand would probably have been acceded to but for the fact that the authorities feared that new discoveries might take place in the near future which would depreciate the value of the existing works. In view of this, it was finally deemed advisable to approve the contract with the electric companies. The policy of many municipalities in Canada, as in Germany, is to saddle the private lighting companies with all the responsibility and expense incident to placing the electric lighting business on an established basis, and when that point shall have been reached, step in and assume control without even offering to buy out the existing works at a fair valuation. This has the appearance of base ingratitude and injustice to the enterprising men who were the pioneers in electric lighting, and who in many instances were induced to embark their means in an untried and doubtful enterprise by the promises of support made to them by the municipalities. It is to be hoped that the Provincial Government wil step in and see justice done—that millions of dollars' worth of valuable property shall not be rendered valueless, but that where it is the desire of the municipality to own and operate an electric lighting plant, it must, as in the case of water companies, purchase at a fair valuation, to be fixed by arbitration, the works of the existing private lighting company.

Relations of Lighting Companies to Municipalities.

A BILL has been introduced in the Ontario Legislature by Mr. Conmee to amend the Municipal Act in respect to municipal lighting. The object of this bill is two-fold. 1. To place gas and electric light companies, in cases where a municipality desires to go into the manufacture of gas or electric light, in the same position as water companies now are where the municipality desires to go into water supply. The present law regarding water companies provides that before the council shall levy any water rate, they shall make an offer for the works or stock of an existing water company, and the water company then can either accept the offer, or may give notice of an arbitration to determine the price to be paid by the municipality for the works. 2. The second proposal in the bill is, to enable municipalities to secure street lighting and lighting for public uses from an existing light company, on fair terms. At present the Municipal Act permits a contract by mutual agreement to be made between a municipality and a company for street lighting and lighting for public uses for a term not exceeding ten years, but a municipality, as the law now stands, has not power to require a company, against its consent, to supply such lighting upon what it may consider to be fair terms. It is therefore proposed by this bill to permit a municipality to make an offer to a lighting company of terms of contract for such lighting, and in the event of the company refusing the offer of the municipality, the municipality will have power to secure an arbitration to determine the price and terms of the contract.

It will be observed that the first of these provisions will not prevent municipalities entering upon the supply of light. It simply provides that if they do enter upon such undertaking, they are first to try to buy, at a fair price, or at a price to be fixed by arbitration, existing works. No valid reason can be advanced why the law, now applicable in case of water-works, should not be extended to light companies as well. Such a purchase will put the municipality in the possession of the very plant and material which they would have to purchase from other sources, if they are going into the business. Gas and electric light companies, as well as water companies, have always come into existence with the consent, encouragement and approval of municipalities, who have granted the use of streets, and in many cases, exemption from taxation for these works. They have thereby induced enterprising citizens to embark their capital in these undertakings. It is unfair and unjust that municipalities themselves should afterwards have power to destroy the value of the very property they have encouraged citizens to purchase and pay for, when that property can be utilized by the municipalities themselves if they so desire. Such a law also benefits municipalities, because it tends to extinguish rivalry to themselves, which rivalry might render municipal operation of these works unprofitable. It is also in the public interest, because it will further encourage private citizens to invest their capital in new enterprises, and in extending and improving existing lighting works. At present, private capital is in danger of being lost through municipal competition, if invested in such works, or in extending and improving existing works, and all private enterprise in these directions is paralyzed and discouraged.

The equitable character of this bill was admitted last year by leading members of the Legislature on both sides of politics, including the Hon. Mr. Hardy and Mr. Whitney. The principle was long since recognized in Great Britain, where the law provides that the municipality cannot interfere with an electric light company until the expiration of twenty-one years, or such shorter period as is specified in the application by the company for the original order. At the end of twenty-one years the municipal authorities may, by notice in writing, require the electric light company to sell their undertaking upon certain terms adjusted by independent authority. If they do not so require, then the company goes on for seven years further ; at the end of that seven years the municipal authorities have again a right to purchase, and so on at the end of every term of seven years.

Municipal ownership in rivalry with an existing company is a case of a whole community going into competition with private individuals who are the shareholders of the existing gas and electric light company. These people are taxpayers, and a part of their money contributed to the municipality would be used in competition to themselves and to confiscate their own property. On economic grounds, it is evident that the purchase of the plant of an existing company would be more profitable both to the company and the municipality than the duplication of plants for competitive service. Duplicating plants involves a waste of capital. The second proposal in this bill, which is just and proper in itself, will remove a grievance which municipalities complain of under the present law—viz., that they have been charged with high rates for street lighting by existing companies, and have been unable to compel companies to furnish such lighting at reasonable rates. By the proposed amendment they will be enabled to secure street lighting either upon their own terms, if accepted by the company, or upon terms to be fixed by fair arbitration. While, on careful consideration, it may be thought desirable to make some slight amendments, the measure as it stands gives evidence of having been carefully framed so as to safeguard all the interests involved. It is therefore highly desirable that it should meet with the approval of the legislators on both sides of the House.

QUESTIONS AND ANSWERS.

"R," LINDSAY, Ont., asks : "When was electric light first used on the streets of Toronto ? When was incandescent light first used as an article of commerce in Ontario ? When was the telephone first used commercially in Ontario ?"

ANSWER.—Electric lights were first used on the streets of Toronto in the fall of 1883. Incandescent lights in series on arc circuits were used in several places in the province of Ontario the following year. The first telephone line in Ontario was built in the city of Hamilton in October, 1877.

TELEGRAPH and TELEPHONE

NEW TELEPHONE REPEATER.

INVENTORS have tried to devise means whereby telephonic messages might be repeated from one circuit into another in order to permit conversation over unusually long distances. Little success has hitherto been attained in this regard. All telephone repeaters, except that about to be described, have the diaphragm of a Bell receiver, or its equivalent, to vary the pressure on the carbon of a microphone transmitter at the end of the first circuit, and so cause a repetition of the message in this circuit. Nearly all repeaters can be used only in repeating messages from the first into the second circuit. None but the new repeater can repeat into an indefinite number of circuits in a manner similar to repeating into an indefinite number of telegraphic circuits.

Telephone repeaters have usually been unsuccessful, because although the amplitude of the diaphragm's vibration in the transmitter is considerable, yet that of the diaphragm in the receiver is very small. Hence, the variation in pressure on the carbon transmitter of a repeater is small, and consequently the telephonic message at the end of the second circuit is very weak, if indeed it can be heard even on short circuits.

In the new repeater a telephone receiver which can speak more loudly than a person is used. This motograph receiver was invented more than twenty years ago by Mr. Edison. It has a cylinder of plaster of Paris moistened with a solution. Pressed against the face of this cylinder is a strip of platinum, the other end of which is fastened to a diaphragm. One line wire is connected with the platinum, and the other with the cylinder. When this is steadily turned by hand or other motor, the strip is drawn forward by friction on the cylinder or released, according as a weaker or a stronger current of electricity passes through the film of chemical solution between the platinum and the cylinder. The platinum, being fastened to the diaphragm, imparts its motions to the same. The diaphragm throws the air into accoustic vibrations, reproducing the sender's voice. The sound of the receiver is dynamically caused by the motor which turns the cylinder. This is turned with more difficulty during the reception of a message than when the line is idle. The electric current which flows on the line merely controls the vibrations o the diaphragm. The motograph has been little used, because Bell's simpler receiver speaks in a sufficiently loud tone for common service.

It recently occurred to the inventor of the new telephone repeater that by using Edison's loud speaking receiver or motograph near the carbon or other suitable transmitter of a second circuit, a message spoken into the first circuit would be repeated with undiminished force into the second circuit. At the end of the second circuit a repeater may be used to forward the message into a third circuit, and so on throughout an indefinite number of circuits. At the end of the last circuit a Bell receiver may be used, if desirable, instead of the motograph. A small electric motor may be used for driving the cylinder of each repeater during business hours. By means of a duplication of transmitting and receiving parts in each repeater, messages may be automatically sent in either direction.

All parts of one or more continents could be brought within speaking distance of one another. The reproduction of a speaker's voice would be louder than the voice itself, because the sounds at each repeater are dynamically due to the motor which rotates the cylinder. The reproduction of the voice at the end of a dozen circuits would be as loud as that at the end of the first circuit.

The inventor has devised a practical telephonograph. At the end of the last circuit a phonograph may be set before a motograph receiver. This will speak as loudly as the person sending the message, hence this may be as deeply impressed on the wax cylinder as if the speaker were present. The phonogram may be detached from the phonograph and sent to the person addressed. He may at leisure place this on his phonograph and listen to the message. The phonogram may be saved, and caused to reproduce the voice of the correspondent at any future time.

JAMES ASHER.

Dunnville, Ont., Canada, March 3, 1899.

LAYING ATLANTIC CABLES.

MR. F. A. Hamilton, E.E., of Halifax, N. S., recently delivered before the Dartmouth Literary Society an interesting talk about the North Atlantic cables, with the laying of many of which he was personally associated. The many difficulties and disappointments which were met in endeavoring to connect the two hemispheres by cable were interestingly and sometimes thrillingly described.

In 1857 the first attempt was made by a United States ship. A start was made and 350 miles of cable payed out, but just when there seemed to be hope of success something caused the cable to part, the end was lost overboard and sank in a hundred fathoms of water, and the 350 miles was lost. In the next attempt two steamers started in mid-ocean one proceeding toward Ireland and the other toward Newfoundland. The end was again lost overboard and 290 miles more of cable were left on the bottom of the sea.

On July 28th, 1858, another attempt was made, this time with better success, for in August both ships arrived simultaneously at Newfoundland and Ireland, having accomplished the work of connecting Europe and America by cable. About 400 messages were transmitted by this cable, some of which were given by the speaker. One of the first was from the directors of the company in England, and occupied about twenty minutes in transmitting. It was, "Europe and America are at last united. Glory to God in the highest and on earth peace and good will toward men." The second message transmitted was from Queen Victoria to the President of the United States. On September 3rd, 1858, this cable had breathed its last, but the feasibility of the work had been demonstrated, and it was not long before it was again taken up.

In 1865 the next attempt was made, with cable of superior quality and with better steamers and appliances. The ships engaged in the work were the Terrible, Sphink and Great Eastern. After the start was made, as the cable was being payed out, the speaker described the intense anxiety on board for fear of losing the connection. When being passed from bow to stern the cable caught in something, and before the ship's way could be checked it had chafed and broken and sank to the bottom in 2,000 fathoms of water. Then commenced a series of drags, but all to no avail; it could not be recovered, and the work was abandoned in 1865.

But the hopes of the men who had undertaken the work never wavered, and in 1866 they were realized. The Great Eastern accomplished the work and established the ties that have never since been severed. The bones of the Great Eastern, on which the speaker had served, had been since distributed among dealers in old iron.

From that time forward great strides had been made. In a short time over 1,600 tons of copper wire had been laid in the North Atlantic. In 1873 and 1874 great work was done, which was continued until nearly every place of any importance whatever has cable connection. In 1874 the Faraday had commenced the work she is still carrying on.

To-day repairing in deep water was no longer the difficult task that it had been. The automatic grapnel was a great aid in the work. As soon as the cable was hooked connection was established and those on board were aware that the cable had been picked up. The ringing of the bell was a welcome sound after long and tedious dragging.

A case of repairing in 1,500 fathoms was described, and the delicate work of raising the cable to the surface without breaking it was shown. It had to be picked up a couple of miles from the break, so that the end would not slip off the grapnel. Then the connection was made and the other end was picked up in like manner. To raise the bight from about two miles of water required about four miles of the cable, so that the two ends thus raised would be ten, twelve or fifteen miles apart. Breaks were accurately located by calculating from the resistance. The break described occurred 1,442 miles from St. Pierre.

SHORT-CIRCUITS.

Mr. Chas. Hosmer, manager of C. P. R. Telegraphs, has returned from the European continent, his daughter in Paris having recovered from her recent illness.

Mr. K. G. Holland, of the Mica Manufacturing Company, of Ottawa, reports that the mining business in the Lake Gerard district, near Wakefield, is brisk this season. The company intend carrying on extensive operations, and will employ upwards of one hundred hands.

The announcement has been made by the Financial Secretary of the Treasury, Mr. R. W. Hanbury, in the British House of Commons, that the government has decided to introduce competition in the telephone service in the country. He asked for a credit of $10,000,000 as a starter in order to enable the Post-office Department to develop the telephonic communication of London.

Mr. Frank Richardson, assistant electrician of the C.P.R., with a staff of assistants, is about to leave Ottawa for the Pacific coast. Acting under instructions from the Minister of Public Works, he will construct a telegraph line from Skaguay to Dawson. The distance is 600 miles, and the cost (on the basis of $250 per mile) will be $150,000. It is expected that the line will be in operation by the 15th of November, 1899.

The annual meeting of the Bell Telephone Company was held in Montreal last month. The directors' report stated: 1,637 subscribers have been added during the year, the total number of sets of instruments now earning rental being 32,082. The company now owns and operates 343 exchanges and 340 agencies. 666 miles of wire have been added to the long distance system in 1898; of these 326 miles are in the Ontario Department and 340 miles are in the Eastern Department. The long distance lines now owned and operated by the company comprise 17,233 miles of wire on 6,096 miles of poles. The receipts for the year 1898 were $1,302,994.04, made up as follows: Exchanges, $935,703.52; long distance lines, $264,455.49; private lines, $12,743.32; miscellaneous, $90,041.71. The expenses were $971,792.30, divided as below: Operating, $897,138.73; legal, $9,582.22; insurance, $13,740.20; bond interest, $47,042.16; miscellaneous, $4,288,99. This left a net revenue of $331,151.74.

MODERN SYSTEMS OF INTERIOR WIRING.*

By L. B. Chubbuck.

When the incandescent electric light was introduced commercially about 1881, in order to supplant its rival gas, it was claimed that the new illuminant required merely the cheapest and simplest kind of wiring. Paraffin covered wire (i.e., copper insulated with two cotton layers soaked in paraffin) had been used before this time for electric bell and telegraph work, and was at once adopted for electric light wiring. This covering was found to be totally useless, however, as often an overheated wire would ignite the inflammable covering, the flame following the wire for long stretches, especially where concealed under the floors or between the walls.

When the underwriters discovered this, they demanded a covering that was non-inflammable. So-called "Underwriters" wire was then introduced, the covering of which consisted of a cotton fibre braid, with a coating of zinc paint on the outside. This wire, while being non-combustible, was not water proof, and where moisture was present, electrolysis was set up, which soon destroyed the wire.

After the short stay of the "Underwriters" wire, a wire insulated with bitumen was brought forward to be used in moist places. This, under the name of "Paragon wire," gave good results for a time, but eventually its insulation was found to crack, and its manufacture was discontinued. Since then various grades of composite and rubber covered wires have been introduced which are water-proof and of high insulation. These have survived to date.

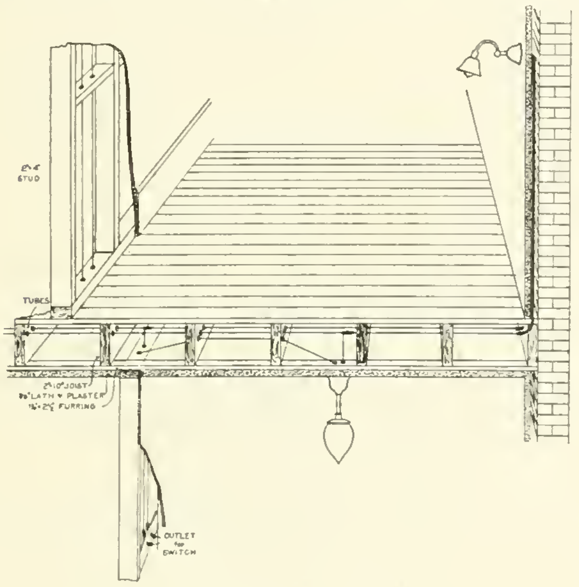

Fig. 1.—Porcelain Tube Work.

A little of the earliest work was done by tacking the wires in place with small metal staples. This soon proved so objectionable, especially with poor grade of insulation then used, on account of grounds, short-circuits, etc., that it has been condemned ever since. A great deal of wiring after this was done with wooden cleats to support the wires in position. The wires were carefully run in respect to being kept away from gas or water pipes, and though no attempt was made to keep them from touching wood or plaster, they have given good satisfaction in nearly all cases where the buildings were perfectly dry. But natural dampness in the atmosphere, a leaky roof or the accidental spilling of water, is most liable to impair the insulation to such an extent that considerable leakage might take place. Fortunately, in this climate the small amount of moisture in the atmosphere has practically no effect on inside wiring, though in foggy districts near the sea coast, and especially in England, a great deal of trouble is experienced from grounds caused by a film of moisture forming over the surface of the fittings. In regard to wires imbedded in plaster, the effect on the insulation is uncertain, depending on the composition of the plaster and the covering on the wire. In some cases the alkalies in the plaster soon break down all insulation on the wire, while there are many instances of specimens of wire testing well after being imbedded in plaster for many years.

To prevent any liability of leakage or chemical action on the wire, it is now supported throughout on porcelain knobs or cleats, and where passing through timber or plaster is surrounded by a porcelain tube. In Fig. 1 is shown a sketch of this method of wiring as installed in the ordinary style of building. As may be seen from the figure, there is considerable open space in the partition walls, under the floors, and in many cases on the outer brick walls, in which the wiring may be concealed. The joists, studding, etc., are bored to receive the porcelain tubes, and the wires run through these tubes, which are made in different sizes and lengths, depending on the size of the wire and the thickness of the timber they are to pass through. The wiring of such a building is most readily done while the building is under construction and before the lathing and plastering is commenced. In finished buildings, where the wiring is to be concealed, the problem is more complicated, and to avoid breaking the plaster, a number of devices are used by different contractors. In passing down the partition walls the best work is done by using bits with shanks that can be lengthened to twelve feet or more, and boring through all obstructions in the partition from top to bottom. In passing down the narrow space between the lathing and brick work on outer walls, what is technically termed a "mouse" is used, consisting of a short chain fastened to the end of a cord. This is dropped down the wall and fished out from below; the wires are then drawn up to the outlet in flexible conduit. In order to conceal the wiring under the floors, some of the flooring is taken up, preferably by carpenters, although in small jobs this work is generally done by the electrican himself. Where thick gummy flooring is encountered, this is a most laborious operation with a hand saw, and a small circular saw is often used to much advantage. The writer has seen a combination of one of these saws geared to a small iron clad motor used for this work, which answered the purpose perfectly. Both saw and motor were mounted on a light wooden frame, by which the saw was moved ahead as the cutting proceeded. The connection to the motor was made by a long twin wire to the mains in the basement.

When it is considered too troublesome or expensive to conceal the wiring in a finished building by lifting floors, etc., the wires are often run in wooden moulding to diminish the unsightliness of open wires across the ceilings or walls. This class of work is much used on steam boats and is especially adapted in wiring panelled rooms, as the moulding may be made to match the woodwork of the room. Considered from an electrical rather than the decorative standpoint, wiring imbedded in moulding is inferior to wiring supported on porcelain and freely surrounded by air. The dissapation of heat is much easier effected in the latter case than in the former, and in a damp place the moulding will cause leakage, as wet wood is a conductor rather than an insulator. A case was met with recently where a No. 8 wire under the action of electrolysis had been entirely wasted away to a green trace of copper salts, by being imbedded in moulding, which had been soaked by a break in an adjoining water pipe. In practice the use of moulding is confined to work which is in full view and quite dry, and is not allowed in concealed work, such as between floors and ceilings, because of uncertainty as to dampness.

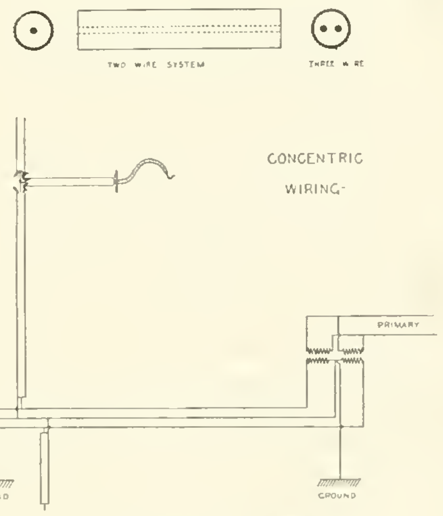

Fig. 2.—Concentric Work.

A method of wiring especially adapted to fireproof buildings, and known as the concentric system, is used to a great extent in England and Germany, though not yet in America. In this system, as illustrated in Fig. 2, instead of using two separate wires, one conductor is enclosed inside of an outer armor, which is used as the other conductor. The inner conductor is a tinned copper wire, which is surrounded with vulcanized rubber, taped and bedded with jute. Over all is bound a layer of galvanized iron wires twisted spirally, forming a complete tube about the inner conductor, and having a conductivity equal to it. For three-wire work, there are two inner conductors, insulated from each other, and from the outer covering, which in this case is used as the middle wire of the system. In both the two and three wire work this outer armor is grounded where the mains enter the building, and at different points along the wiring, if the stretches are long. A case may occur where the terminals of two separate concentrics which are on long circuits come a short distance apart. If one of these cables is fully loaded while the other is idle, there may be a "drop" of 2% on the loaded cable to no "drop" at all on the other, which will cause a difference of potential of 1% between the outers at the ends of the two cables. This under certain conditions is sufficient to set up electrolysis, which in time would destroy the covering of one or both cables unless they are both well grounded at these ends. For alternating current work, unless for short runs, both conductors must be run in the outer covering, as in the case of a single conductor in an outer iron armor, the drop along the line will be increased by impedence due to the alternating current.

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* Paper read before the Engineering Society of the School of Practical Science, Toronto, and published by permission.

The advantages of the concentric system are, that there is practically only one wire to run, and this may be buried in plaster or run over iron work with impunity. The cable itself also is quite small, being for a No. 12 wire only $\frac{5}{8}$ in. in diameter, and as no insulators are required it is very easily concealed. Since it is armored, it is unaffected by nails, etc., and in case of any rough usage, such as the rupture of the cable by a chisel, a dead short-circuit is formed, which blows the fuse immediately, without any arc being formed external to the cable. The adherents of this system claim, like Mark Twain, that it is best to put all your eggs in one basket and then "watch that basket." They argue that it is better to put all the insulation on one conductor, and to see that this insulation is well protected, than to have two conductors, each liable to a breakdown. The disadvantages of this system are, first, the obvious difficulty in making the joints, and, second, having the outer grounded, which is a disputed question. This system is used chiefly in isolated plants or in buildings using alternating current and supplied from separate tramsformers, as there would probably be considerable electrolysis of gas and water mains where there was a network of bare outer conductors all over a city.

Tho concentric system is not used in America, and in the modern type of fireproof buildings, having brick partitions and floors of brick arches across the steel floor beams, the frail system of wiring on porcelain knobs is unsuitable. There is usually no free space along the floors or in the walls for running the wires, and even if there were such a space, the chances are great that falling mortar or brick would either break the wires or ground them on the steel frame work. To provide protection and accessibility to the wiring in such buildings, the conduit systems have been evolved. As far back as 1885 there are instances of wiring on some steamers being run in small brass pipes. The inside of the pipes was smooth, and as the runs were not long, the flexible cord used was easily threaded through the pipe from one opening to the next. Speaking tubes were tried about this time to act as a channel for the wires, but it was found that the conductors could not be inserted or withdrawn freely, and speaking tubes for this purpose were discarded. Since that time there has been very largely used a tube of papier mache, impregnated with a bituminous compound, to render it impervious to moisture and also to increase its insulation. It was found, however, that when this "plain conduit" was concealed in plaster, it was ultimately destroyed by chemical action. Another form of conduit, called circular loom or flexible conduit, is now used extensively. The inner portion consists of a tube formed by a strip of treated paper wound in a spiral; over this is a braided covering coated on the outside with flakes of mica. Though the inner tube is rather inflammable, the outer tube will withstand quite a flame for some time.

The next step was to cover the plain papier mache tube with a thin brass sheath having a longitudinal seam. This brass armored conduit was thought at one time to be near perfection, but even it was found to have its faults. It withstands chemical action to some extent, but is not completely waterproof, and, like all the preceding forms of conduit, it is very susceptible to mechanical injury. Much of the trouble with brass armored conduit has been due to the poor manner in which it was installed, as moisture entering at the outlets or at poor joints is absorbed by the inner lining, which in time will ground the wires on the outer covering.

Several tests were made in the school laboratories on both the circular loom and brass armored conduit, to determine their insulation under the presence of moisture. These tests were made by the condenser method in connection with an electrostatic voltmeter. It was found that in the case of the circular loom, though of fairly high insulation when dry, the insulation resistance fell off very rapidly under the presence of much moisture. The brass armored conduit tested well when dry, and also with moisture for a short time. When exposed, however, to damp for some time, especially if the armor was defective, the insulation fell off, the effect of grounding being more noticeable in the case of the brass armored conduit than with the circular loom, on account of the metal covering.

For absolute mechanical and moisture protection, the iron armored conduit is now used. It has been made with insulating linings of paper, wood, rubber, cement, enamel and asphaltic compound. The metal tube should be the minimum of metal for strength and rigidity, and the lining, besides being capable of bending with the pipe without cracking or splitting, must be impervious to heat and moisture. There has been much discussion as to whether an insulating lining is necessary in a metal pipe which is perfectly waterproof and the wires it contains are insulated up to many megohms per mile. At the World's Fair (1892) all forms of pipe tubing and conduit then manufactured were rejected, and plain iron pipe was finally adopted, in which the distribution wires were run. Although some of these wires were carrying a 2,000-volt alternating current, no faults whatever were developed. There are also thousands of miles of plain iron pipe now used for underground service for high potential mains in cities, which have given perfect satisfaction.

In spite of these facts, a thin insulating lining is always used for interior conduit work, for several reasons. All the iron pipe as now manufactured on a large scale is very rough on its interior, due to burrs, fins and splinters, and in pulling a wire through a long stretch of this pipe the insulation is very liable to be torn, especially in rounding corners, elbows, etc., in the smaller sizes of pipe. A plain iron pipe is also liable to sweat internally, and any rust due to moisture in the conduit is a menace to the insulation on the wire. Thus a thin lining is useful as tending to preserve both the pipe and the insulation.

There are two styles of iron armored conduit very extensively used, one having a lining of treated paper and the other a thin coating of enamel both inside and outside. The lining in the latter conduit is very hard and as smooth as glass, which is an advantage in inserting the wires. These iron armored conduits are manufactured in the regular gas pipe sizes externally, and in coupling the standard gas pipe threads are also used.

DISTRIBUTION.

The system of distribution to be used in a building depends to a large extent on the character of the building, whether the lights are scattered, as in the case of a business block, or arranged in groups in a large electrolier, around the stage, etc., as in the case of a theatre. One of the most general methods of distribution is shown in Fig. 3, which gives an isometric sketch of the feeder system in one wing of a modern office building. In this system of wiring all the branch circuits (not shown) on each floor are run from one or more distribution boxes or cabinets on that floor. The panel boards in these cabinets are supplied from the switchboard in the basement by a system of risers or feeders running up one of the side walls to the cabinets. In conduit work a two-wire system is usually employed throughout the building, and a separate pair of feeders run up from the switch-board to each distribution box. Or where the load is light, and separate control for each floor from the basement is not required, the panel boards on two or three adjacent floors are supplied from one pair of feeders. In order that the public lights along the halls, staircases and elevators may be independent of the other lights in the building, it is customary to run a pair of feeders from the base-

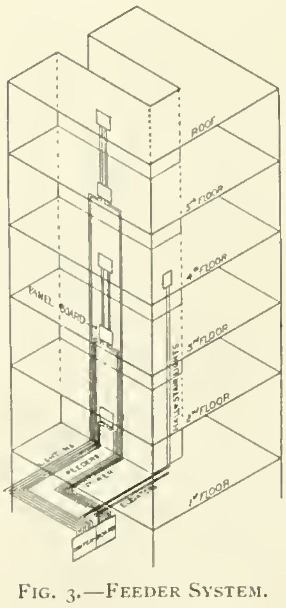


FIG. 3.—FEEDER SYSTEM.

ment to one or more separate panel-boards on certain floors from which these lights are wired. In case current is required for running motors for printing presses, etc., on some of the floors, the main panel boards on these floors are divided into two sections, one part for the lighting and the other for power service. This power section of the panel board is supplied by separate feeders from the power panel of the switch-board, from which are also run the mains for the elevator motors.

Where ventilating motors are used in a building, they are usually placed immediately under the roof and wired from the power panel in the top floor. To start or reverse these from the basement, a magnetic switch is often placed in the branch circuit to the motor, and the four small controlling wires from this switch run to the basement in one conduit. By the use of these automatic switches, motors, lights, etc., may be controlled from distant points without the expense of diverting the heavy main wires. They can be used in controlling dummy waiters from different floors, and also as the ordinary three and four point switches in lighting an electrolier from several different places. Where the building is to be wired for electric bell, telephone or ticker service, weatherproof wire is generally used throughout for this purpose, and all the wires from each floor run in a single conduit to a distribution box in the basement.

INSTALLATION.

In Figs. 4 to 11 are shown details of different parts of conduit electric wiring as installed in a fireproof office building. The conduit is installed at that stage in the construction of the building after the brickwork in the flooring and walls is finished, but before any plastering is started. Since even the smallest size of conduit (⅜″) is generally too large to be covered by the layer of plaster on the brick walls, it is necessary to cut shallow channels in the brickwork wherever the conduit is to run on these walls. This is a tedious job, and is usually done by a gang of men with hammers and cold chisels before the regular conduit work is started. Where there are a number of vertical feeders requiring large conduit to be run, arrangements are made with the architect to have a recess left in the brickwork of sufficient width and one brick deep from the basement right up to the roof. A good place to run this channel for the feeders is up the elevator enclosure. This is generally in a central location, which is convenient for the panel boards, and besides this there are no windows, partitions, walls, etc., to dodge around in running the feeders to the basement. Fig. 4 shows the manner in which the feeder conduits are run in the wire way and their connection to the distribution box, also the smaller branch conduits leading from the box to the different circuits.

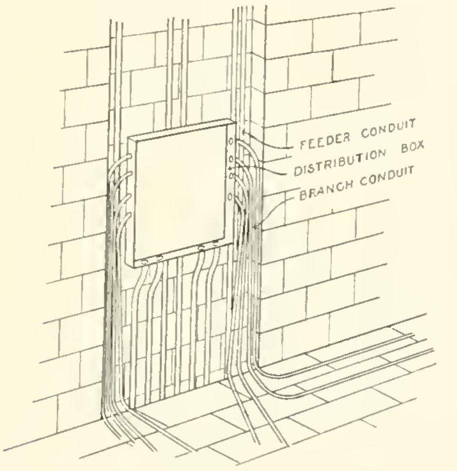


FIG. 4.—WIRE WAY.

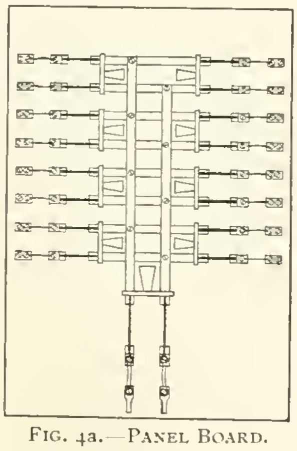


FIG. 4a.—PANEL BOARD.

On account of the large size of wire used for the feeders, a separate conduit is generally run for each wire. If, however, an alternating current is to be used in the building, this arrangement of one conductor in an iron tube will cause a loss of energy by induced currents set up in the iron. It is thus necessary to use brass armored conduit or to neutralize this effect by running both wires in the one tube.

In the branch circuits two wires or a twin wire are almost always run to a single conduit, and the wiring differs in some respects from ordinary methods. In ordinary work, where a number of lights are installed in a room, the mains are run down the length of the room and branches tapped off to each lamp, as shown in Fig. 5. In conduit work, however, no tee's are placed on the conduit, and a zig-zag path is taken from one outlet to the next. In afterwards inserting the wires they are run to the furthest outlet, and, working back, a loop is left at each of the other outlets, to which the wires from the fixture are connected. Thus in this "loop system" (Fig. 6) the branch wires are not cut at any place between the panel board and the furthest outlet, so that if larger wires are afterwards required, the different fixtures may be disconnected, the old wires pulled out from end to end, and the larger wires inserted.

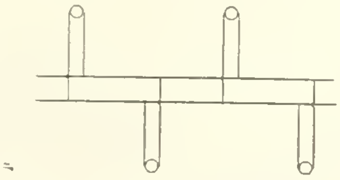


FIG. 5.—ORDINARY WIRING.

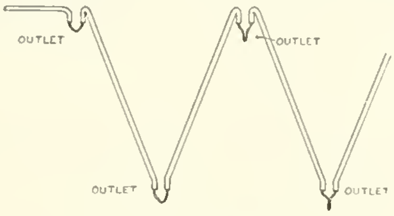


FIG. 6.—LOOP SYSTEM.

Some details of the conduit work on branch circuits are shown in Figs. 7 and 8. It will be noticed that the conduit is run on the brick flooring and not across the ceilings. This is because the plaster on the ceilings is not thick enough to cover the iron armored conduit, and since the brick flooring is afterwards covered by two to four inches of cinders, over which asphalt or the floor boards are laid, the tubes are completely concealed. In both these figures outlet boxes are used, into which the ends of the conduit at the outlet are sealed. These outlet boxes are made of iron, with a lining of the same material as that used in the conduit. Two common forms are shown in Figs. 9 and 10, the first of which is an outlet box shaped to act as a receptacle for a flush switch. Fig. 10 gives a form used at a bracket outlet, showing the nipple on the cover by which the bracket is supported. In many buildings, however, outlet boxes are not used, especially for bracket and ceiling lights, the conduit being trimmed off nearly flush with the plaster and the fixture connected up in the usual manner. When one or more branches are to be tapped off the mains for an electrolier, etc., a "junction box" is used. These are very similar to outlet boxes and often contain a branch

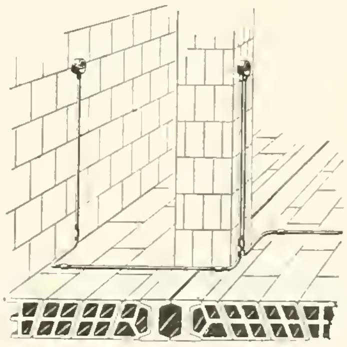


FIG. 7.—DETAILS OF BRANCH CIRCUITS.

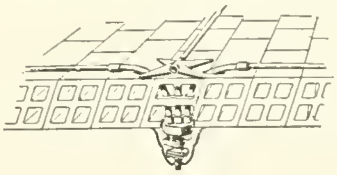


FIG. 8.—DETAILS OF BRANCH CIRCUITS.

cut out, making them practically a distribution box on a smal scale.

The wiring in the basement is usually run open, i.e., not concealed in the plaster, and is often run in flexible conduit or on porcelain knobs, though for fireproof work the iron armored conduit is continued to the switchboard. A very useful support, made from gas pipe, for carrying the conduit in the basement is shown in the upper portion of Fig. 11. This figure also shows a form of switchboard suited to the feeder system in Fig. 3, each pair of feeders being controlled by a double pole switch.

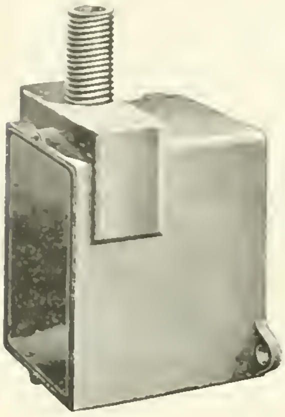


FIG. 9.—OUTLET BOX.

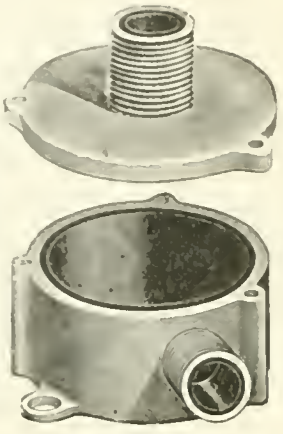


FIG. 10.—OUTLET BOX.

It is not permitted when installing the conduit to run cords in the stretches as they are put up, to facilitate pulling the conductors through afterwards, as this might make poor construction possible; that is, it would be an easy matter to pull even large wire through a conduit having rough, poorly made joints, which would abrade the insulation on the wire. When the wire is run through the conduit properly, it is practically a gaurantee that the conduit has been well installed or the conductors could not be inserted. For this same reason, it is important to have all necessary curves as gradual as possible or difficulty will be had in running the wires afterwards. In making a correct joint in iron armored couduit, a wheel pipe cutter is used to cut merely through the outer iron armor, a hack-saw being used to saw through the lining. A reamer is then used to trim up the end of the conduit before it is threaded. A jack-knife is often used instead of the reamer, but a poor job is generally the result. Care should also be taken that the white lead used in sealing the joint does not get between the ends of the conduit. This can be prevented by giving the coupling a turn or two on the conduit, and then applying the lead to the thread on the outside of the conduit.

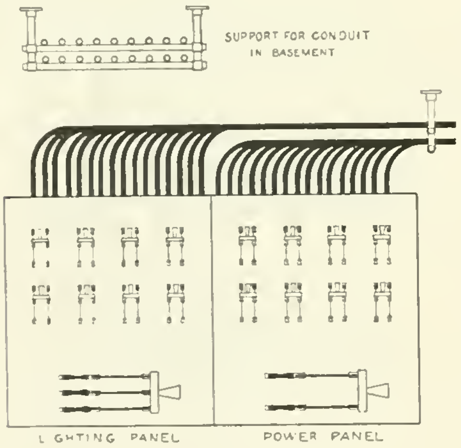


FIG. 11.—SWITCHBOARD.

The actual wiring of the building by running the conductors through the conduit is not done till all the plastering, flooring, etc., is over and the building is nearly finished—in fact, the wires are often run and the fixture work done at the same time.

There is not much difficulty in running the risers or feeders, as the conduit is large, and the wire, where larger than No. 6, is generally a stranded conductor. On the horizontal branch circuits, however, with many turns and using twin wire, the problem is not so simple. The inside surface of the conduit is first rendered smooth by blowing some powdered soapstone out of a horn through a section of the conduit. A steel tape about $\frac{3}{16}$" wide and as thick as a clock spring is then passed through the conduit, after which the wires may be run. The tape is always run downwards if possible from a higher to a lower outlet. An ordinary stretch for a run is from fifty to eighty feet with three or four turns, though it is sometimes possible to thread the steel tape nearly two hundred feet on a horizontal run.

In conclusion, it may be stated, that on account of the high standard of insulation now used on wire, any system of wiring is practically perfect where the insulation is protected from mechanical and chemical injury. The system to be employed in any special case depends on the circumstances. In some cases one system may be perfect, while in others it is expensive and unnecessary. In the best practice iron armored conduit is used in fireproof buildings or where the wiring is embedded in plaster or brick work. For the ordinary class of buildings with wooden joists, etc., where there is no liability of mechanical abuse, porcelain work is perhaps as good a system as can be used. In any case, where the wiring is properly done, the incandescent electric light—in contrast to the explosive and poisonous character of ordinary lighting gas—is probably the safest method of illumination yet devised by man.

THE BURSTING OF SMALL CAST IRON FLY-WHEELS.

MR. Chas. H. Benjamin, of Cleveland, Ohio, in a paper presented recently to the American Society of Mechanical Engineers on the above subject, states the following as his conclusions on the subject, based upon careful experiments:

1. Fly-wheels with solid rims, of the proportions usual among engine builders and having the usual number of arms, have a sufficient factor of safety at a rim speed of 100 feet per second if the iron is of good quality and there are no serious cooling strains. In such wheels the bending due to centrifugal force is slight, and may safely be disregarded.

2. Rim joints mid-way between the arms are a serious defect and reduce the factor of safety very materially. Such joints are as serious mistakes in design as would be a joint in the middle of a girder under a heavy load.

3. Joints made in the ordinary manner, with internal flanges and bolts, are probably the worst that could be devised for this purpose. Under the most favorable circumstances they have only about one-fourth of the strength of the solid rim, and are particularly weak against bending. In several joints of this character, on large fly-wheels, calculation has shown a strength less than one-fifth that of the rim.

4. The type of joint exemplified in Nos. 16 and 17 is probably the best that could be devised for narrow-rimmed wheels not intended to carry belts, and possesses, when properly designed, a strength about two-thirds that of the solid rim.

It is gratifying to notice the fact that since the subject of joints in fly-wheel rims has been so thoroughly ventilated during the discussions before this society, several of our prominent engine builders have changed the designs of their wheels by bringing the rim joints opposite the ends of the arms. The experiments which have just been described, although at times a trifle too exciting, were interesting from first to last. The writer hopes to supplement them by others on models of the more recent rim-joints, and would be glad to receive any suggestions. The more this subject is agitated, the less shall we have occasion to mourn the destruction of life and property on account of faults in the design of this most necessary element of the steam engine.

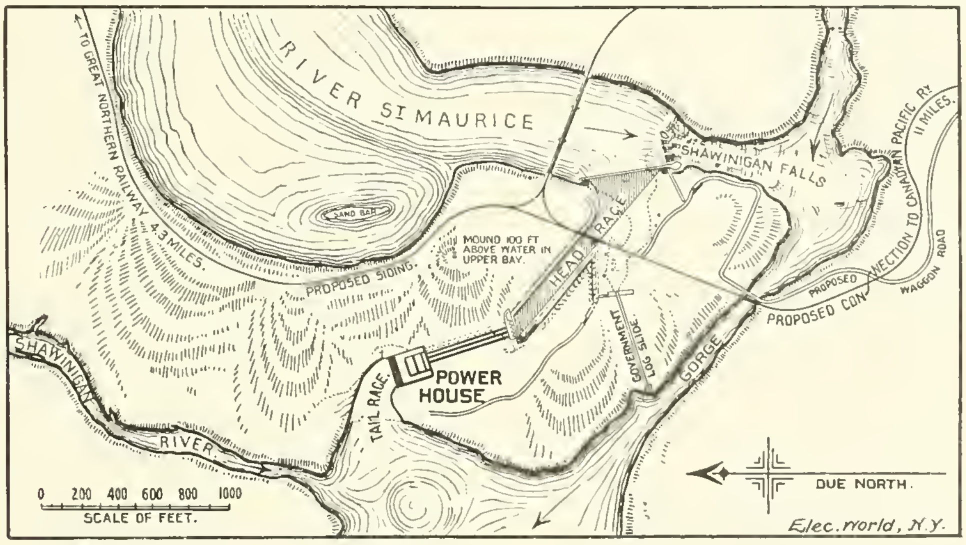
Mr. C. H. Meredith, of Ottawa, is working on an invention to prevent anchor ice.

PROPOSED WATER POWER DEVELOPMENT AT SHAWINIGAN FALLS, QUE.

A WATER power development of rather unusual interest, the construction of which will soon be commenced, is that of the Shawinigan Falls, on the St. Maurice River, P.Q. This power and over 800 acres of land adjacent thereto are owned and will be developed by the Shawinigan Water and Power Company, of Montreal.

At these falls the river, which is one of the largest in Canada, draining some 18,000 square miles of territory, drops over 140 feet in a very short distance. The extraordinary formation of the peninsula of land lying between the upper and lower levels of the river above and below the falls, and the way in which the river turns at more than a right angle to its course after hurling itself down the main cascade, here affords what is undoubtedly one of the most favorable natural locations for a water power development in the world.

Owing to the nature of the country drained, which is densely wooded throughout, the flow of water in this stream is very steady throughout the year. At lowest water it is calculated that sufficient water passes over the falls to develop 190,000 horse-power, under the working head of 120 feet, on the shafts of turbines having 80 per cent. efficiency. Of this amount 150,000 horse-power could safely be used.



Map Showing Proposed Water Power Development at Shawinigan Falls.

The falls are favorably situated as regard saccess to rail and water shipping facilities. The Great Northern Railway, which is a link in the short line route from Chicago and Parry Sound to Quebec by way of Ottawa, passes close to the falls, and the construction of a siding 4½ miles long to this road will be commenced in the early spring. This will give communication with Quebec, 90 miles distant in one direction, and with the great west by the shortest known route, in the other direction. The Canadian Pacific Railway, Canada's transcontinental line, passes within 10 miles of the falls on the opposite side of the river, and a siding from this road has been located by the engineers. The operation of the Montreal and Quebec division of the Canadian Pacific Railway and a considerable section of the Great Northern Railway by electricity, using either the trolley or the third-rail system, is claimed by the engineers to be well within the commercial possibilities of this development.

Three Rivers, a town of 9,000 inhabitants, at the junction of the St. Maurice river with the St. Lawrence river, and 17 miles distant from the falls, is a seaport with excellent shipping facilities, which afford means of water communication with the ocean and the great lakes for eight months in the year. The Canadian Pacific Railway passes through this town, and the Grand Trunk railway is reached by means of a ferry to the opposite shore of the River St. Lawrence. It is intended to transmit power under 20,000 volts pressure to this town for manufactures of various kinds on an extensive scale.

The present development, for which contracts have been let, and on which construction will be commenced shortly, will consist of the installation of turbines and generators for 30,000 horse-power, with provision for extension up to 150,000 horse power. Twenty thousand horse-power of this will be in the form of alternating current for transmission to Three Rivers, and 10,000 horse-power in low-voltage direct current, to be used in various electro-chemical industries in the vicinity of the falls. The water is to be taken in from the side of the river just at the head of the falls, and carried back in a head-race 1,200 feet long, 100 feet wide and 16 feet deep. The arrangement of the head-race entrance will naturally tend to allow the draft over the falls to carry off the frazil and anchor ice which is such a bugbear to all engineers who have to deal with water powers in Canada.

The bulkhead is to be of concrete, with steel grates operated by pneumatic pressure, in front of feeder-pipe inlets, and from here the water will be carried down in steel feeder pipes 13 feet in diameter and about 550 feet long. Each of these pipes will carry sufficient water to develop 10,000 horse-power net, under the working head of 120 feet. Two of the pipes will be connected to two pairs of twin turbines, each of 5,000 h.p. capacity, running at 300 revolutions per minute, each direct connected to an alternating-current 5,000 h.p. generator. These generators will be among the largest horizontal shaft generators yet built, and will weigh in the neighborhood of 100 tons. A pair of gate valves 78 inches in diameter, with pneumatic lift, will control each unit of 5,000 horse-power, so that should one unit require to be stopped, the opposite one on the same pipe can be kept running. The turbines operating the direct-current generators will consist of four pairs of twin turbines, each of 2,500 h.p. capacity, having two direct-connected generators, one on each end of the driving shaft. Each of these 2,500 h.p. units will also be controlled by separate gate valves.

A special feeder pipe 4 feet in diameter will run the exciters and the air compressor, supplying air for the operation of gate valves, switches, etc. All the feeder pipes are to be coned down and provided with numerous pop valves and large air cushion cylinders to relieve water hammer. The governors will be operated by compressed air, and in operating the cylinder gates of turbines a novel arrangement has been devised, so that no moving part of the mechanism will operate under water. Roomy tunnels well above back-water level will run between the generators and switchboards and transformers. The switches will be operated by compressed air, and the switchboard is so located as to overlook all the generators and exciters.

The transmission lines to Three Rivers, operating under a pressure of 20,000 volts, will be two in number, one on each side of the river, so as to avoid the risk of total loss of line from forest fires which might occur in the wooded country through which the lines will pass. These lines will be 17 miles long, of which 15 miles will be dead straight. Wire will be bare copper, on triple petticoated insulators set on suitable cross arms on heavy cedar poles set 6 feet into ground, 100 feet apart.

A triple line of lightning arrestor wires, grounded at every fourth pole, will be carried over the transmission lines. The transformers at both ends will be oil-filled self-cooling.

Messrs. T. Pringle & Son, of Montreal, are the company's engineers for both the hydraulic and electrical development, W. C. Johnson, engineer of the Niagara Falls Hydraulic Power & Manufacturing Company, being consulting engineer. Wm. Israel Bishop will be engineer in charge, and F. H. Leonard will have charge of the designing and installation of electrical apparatus.

For the above particulars we are indebted to the Electrical World.

INSPECTION OF STEAM BOILERS IN BRITISH COLUMBIA.

The Legislature of the province of British Columbia has passed a bill, which received its third reading on February 13th last, to provide for the inspection of steam boilers. It is entitled "An Act respecting the Inspection of Steam Boilers," and is as follows :

ACT RESPECTING THE INSPECTION OF STEAM BOILERS.

Her Majesty, by and with the advice and consent of the Legislative Assembly of the Province of British Columbia, enacts as follows :

1. This Act may be cited as the "Steam Boiler Inspection Act, 1899."

2. The expression "boiler" wherever the same occurs in this Act includes the steam engine or engines, and every part thereof, and all apparatus and things attached to and connected therewith, or used with reference to any such boiler or engine.

3. This Act shall not apply to railway locomotives on railways under the supervision of the Dominion of Canada, nor to any boiler subject to inspection under the laws of the Parliament of Canada, nor to any boiler with a capacity of two horse power or under.

4. The Lieutenant-Governor in Council may constitute such portions of the Province as he may think proper into Steam Boiler Inspection Districts, and may, from time to time, alter such districts.

5. For each of such districts the Lieutenant-Governor in Council shall appoint an Inspector, to be called Inspector of Steam Boilers.

6. It shall be the duty of each Inspector to inspect the steam boilers within his district before the same shall be used, and once at least in each year to inspect and thoroughly test all steam boilers within his district.

7. Nothing in this Act shall be construed to prevent the use of any boiler or steam generator which may not be constructed of riveted iron or steel plates, when the Inspector has satisfactory evidence that such boiler or steam generator is equal in strength and as safe from explosion as boilers of the best quality constructed of riveted iron or steel plates.

8. (1.) Every steam boiler shall be provided with a fusible plug, approved by the Inspector, inserted in the flues, crown sheet or other part of the boiler most exposed to the heat of the furnace when the water falls below the prescribed limits, so that the plug will fuse and put out the fire.

(a.) Each boiler shall have a safety valve of approved pattern of not less than one square inch of area to three square feet of grate surface ; if it be a water tube boiler, it shall have one square inch of area to six square feet of grate surface. This safety valve shall be set by the Inspector to the pressure of steam allowed by him.

(b.) No person shall alter in any way the weight, or if a spring loaded safety valve is used, no one shall alter the spring so as to carry a greater pressure than allowed by certificate of Inspector, under a penalty of not exceeding one hundred dollars.

9. Every steam boiler shall also be provided with one or more steam gauges, tricocks, gauge glass and safety valve, tested annually, unless the Inspector shall specially certify the same to be unnecessary.

10. The certificate of inspection to be granted under this Act shall be in the form set out in Schedule A.

11. The said certificate, together with a copy of sections 21 and 22 of this Act, shall be posted up, and be kept posted up in a conspicuous place on the steam boiler, or in the engine room where such steam boiler is being operated, in such place as the Inspector shall direct, and no person operating such steam boiler shall operate the same at a higher pressure than that authorised in the certificate.

12. (a) An appeal shall lie from any ruling or decision of an Inspector, to the Chief Commissioner of Lands and Works, whose decision shall be final, and the said Chief Commissioner shall have power to order the payment of a reasonable sum for costs, and in case of default in payment pursuant to such order, the same may be recovered in any Court of competent jurisdiction by the party or parties to whom awarded.

(b) In any appeal it shall be lawful for the Chief Commissioner of Lands and Works, if he think fit, to summon to his assistance an expert engineer who shall attend and assist accordingly.

13. In addition to the annual inspection, it shall be the duty of each Inspector to examine at any time, when in his opinion such examination shall become necessary, all such steam boilers within his district as shall become unsafe from any cause, and to notify the owner or person using such steam boilers of any defect, and what repairs are necessary in order to render them safe.

14. The Inspector shall have the right, at all reasonable hours, to examine steam boilers in course of construction or repair, and to refuse to grant a certificate for any steam boiler found to be defective according to the provisions of this Act, or of which such examination has been refused.

15. Each Inspector shall keep a register of the inspections and certificates made and granted by him, of all repairs ordered by him, of all steam boilers condemned by him as unsafe, of all accidents to steam boilers whether by explosion or otherwise, and of all casualties that may happen or occur in connection with steam boilers within his district.

16. The Chief Commissioner of Lands and Works may order an investigation to be made, by any person or persons, into the cause of any accident to any steam boiler, attended or not attended with loss of life, and the person or persons so appointed may summon witnesses and compel their attendance before him or them, by the same process as Courts of Justice, and may administer oaths and examine witnesses touching the cause of such accident, and shall report thereon to the Chief Commissioner.

17. Each Inspector shall annually, on or before the first day January, send to the Chief Commissioner of Lands and Works a concise report of all inspections and transactions connected with the performance of his duties, and of all accidents and

casualties to steam boilers, whether by explosion or otherwise, that have happened or occurred within his district during the year.

18. The fees to be paid for inspection and the salary of the Inspectors shall be fixed by the Lieutenant-Governor in Council.

19. Every person who constructs steam boilers known to be imperfect, or who drifts any rivet hole to make it come fair, shall be liable to a fine of two hundred dollars.

20. It shall be the duty of owners or managers of steam boilers to allow the Inspector free access to the same, and to furnish water and fill the boiler and remove the jacket or covering when directed by the Inspector, to enable the Inspector to make a proper test, and all engineers operating such steam boilers shall assist the Inspector in his examination, and shall point out to him any defect that they may know or believe to exist in the steam boiler in their charge, subject to a penalty of not less than twenty dollars nor more than three hundred dollars.

21. Any person operating a steam boiler, as well as the lessee or owner thereof, in case the same is being operated with his consent, without there being an unexpired certificate of inspection thereof, shall be liable to a penalty of five dollars a day for each day that he shall operate such uncertificated steam boiler; provided, however, that the penalties herein enacted shall not take effect until after the expiration of four months after this Act shall have come into force, nor in cases where there is no such certificate owing to the neglect or default of an Inspector.

22. It shall be the duty of the person operating or owning any boiler pronounced by the Inspector unsafe, to cease to use the same until such repairs as are indicated by the Inspector are made, and in case of failure to comply with the requirements of the Inspector, the person owning, as well as the person operating, any such boiler shall be liable to a fine not exceeding one hundred dollars, and shall also be liable for any damage to person and property resulting therefrom.

23. Any Inspector who shall wilfully certify falsely regarding any steam boiler shall, on conviction, be liable to a fine of not less than fifty dollars and not exceeding five hundred dollars.

24. Any person violating the provisions of section 11 of this Act shall be liable to a penalty of not less than ten dollars and not more than fifty dollars.

25. No Inspector shall act as agent for the sale of boilers under a penalty of removal by the Lieutenant-Governor in Council.

26. Any penalty recovered under this Act shall form part of the Consolidated Revenue Fund.

27. All penalties imposed under this Act shall be recoverable before a Justice of the Peace, a Police Magistrate, or a Stipendiary Magistrate. Such Justice of the Peace, Police Magistrate, or Stipendiary Magistrate, in case the penalty awarded by him be not forthwith paid upon conviction, with such costs as shall be awarded, shall levy the same by distress and sale of the goods and chattels of the offender, by warrant under his hand and seal.

28. In default of the payment of the penalty and costs, or of sufficient distress, the offender may, by warrant under the hand and seal of the convicting Justice of the Peace, Police Magistrate, or Stipendiary Magistrate, be imprisoned in the nearest goal or lock-up for a period of not less than fourteen days, and not more than six months, at the discretion of such Justice of the Peace, Police Magistrate, or Stipendiary Magistrate.

29. No conviction or warrant of commitment under this Act shall be vacated, quashed or set aside for want of form, or be removed by writ of certiorari or other process into the Supreme Court.

30. (a) The Lieutenant-Governor in Council may make rules and regulations for the testing of steam boilers, and all matters connected with the construction and working thereof, including the examination of persons in charge of same.

(b.) Any rules and regulations made under the authority of this section, shall, after publication in the British Columbia Gazette, have like force and effect as if herein enacted.

SCHEDULE "A."

CERTIFICATE OF INSPECTION OF STEAM BOILER.

PROVINCE OF BRITISH COLUMBIA. } This certificate expires 18 .

I hereby certify that I have this day inspected the steam boiler owned by of in the Province of British Columbia [GIVE DISCRIPTION OF STEAM BOILER BY WHICH IT MAY BE READILY IDENTIFIED], and having carefully examined said steam boiler, have found the same in condition, and therefore authorize a steam pressure of pounds to the square inch and no more.

Dated this day of 18

INSPECTOR.

MUNICIPAL LIGHTING PLANT AT ACTON.

THE village of Acton, Ont., is now supplied with arc and incandescent electric lights by a municipal plant, which was started up for the first time on January 28th, just two months and one week after the contracts were signed.

The power house is a stone structure, 24 × 50 feet, floored with maple, with walls and trimmings of dressed red birch. The engine and dynamo room is 24 × 37 feet, and the boiler room 24 × 13 feet. The engine is of the Wheelock type, capacity 75 h.p. nominal; and the boiler 90 h.p. These were supplied by the Goldie & McCulloch Co., Galt, and uphold the reputation of that well-known firm. The dynamo is a fifty kilowatt alternating current machine, with a capacity of 1,000 incandescent lights. There is a fine two-panel marble switchboard, with full complement of controlling instruments, and 56 32 c.p. incandescent street lamps, arranged in two circuits independent of each other, and a third circuit for domestic and commercial service, also independent. The electrical machinery, wiring, etc., was contracted for by the W. A. Johnson Electric Company, of Toronto. The main driving belt is 16 inches, 65 feet long, and the dynamo belt is a 10 inch, double, endless. Both were supplied by the belting department of the Acton Tanning Company.

Mr. Reynolds, the electrician, had the general oversight of plans and arrangements; Messrs. Forbes and Graham of the erection of the power house; Mr. W. Cowan, of the Goldie & McCulloch Co., of the placing of the boiler and engine; and Mr. H. J. Hurd superintended the construction of the electrical work for the W. A. Johnson Electric Co.

MOONLIGHT SCHEDULE FOR MARCH.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 6.10	P.M. 11.30	5.20
2....	" 6.10	A.M. 1.00	6.50
3....	" 6.10	" 1.30	7.20
4....	" 6.10	" 2.40	8.30
5....	" 6.20	" 3.30	9.10
6....	" 6.20	" 4.20	10.00
7....	" 6.20	" 5.10	10.50
8....	" 6.20	" 5.20	11.00
9....	" 6.30	" 5.20	10.50
10....	" 6.30	" 5.20	10.50
11....	" 6.30	" 5.20	10.50
12....	" 6.30	" 5.10	10.40
13....	" 7.40	" 5.10	9.30
14....	" 8.40	" 5.10	8.30
15....	" 9.40	" 5.10	7.30
16....	" 10.50	" 5.10	6.20
17 ...	" 11.00	" 5.10	6.10
18....	" 11.50	" 5.10	5.20
19....	....	" 5.10	4.30
20....	A.M. 12.40	.....	
21....	" 1.20	" 5.00	3.40
22....	" 2.00	" 5.00	3.00
23....	" 2.30	" 5.00	2.30
24....	No Light.	No Light.	.....
25....	No Light.	No Light.	.....
26....	No Light.	No Light.	.....
27....	No Light.	No Light.	.....
28....	P.M. 6.50	P.M. 9.20	2.30
29....	" 6.50	" 10.20	3.30
30....	" 6.50	" 11.30	4.40
31....	" 6.50	A.M. 12.30	5.40
		Total.........	185.30

THE PITTING OF BOILERS.—Investigations have been made by M. Olory, a French engineer, in regard to the pitting of boilers, the result showing that the powder thus formed contains 86.29 per cent. peroxide of iron, 629 per cent. of grease and other organic matter, and 4.25 per cent. of lime salts. In one of the tests resorted to a polished iron bar was first immersed in a natural water containing much oxygen and no lime salts; the bar gradually rusted, the corrosion ceasing when the oxygen was used up—the bar being now removed, repolished, and put back, it remained perfectly bright. Repeating the experiment, with water containing lime, the rusting was much less complete, the lime salts forming a protective layer on the iron, but on polishing this off corrosion recommenced. In distilled water the bar remained quite bright. The corrosion is much more rapid if the water contains carbonic acid gas as well as oxygen.

MONTREAL

(Correspondence of THE CANADIAN ELECTRICAL NEWS.)

McGILL UNIVERSITY LECTURE—"ELECTRICITY AS A FACTOR IN MODERN DEVELOPMENT."

The annual university lecture of McGill was delivered on February 17th before a large and representative audience, the lecturer being Prof. R. B. Owens, chief of the electrical department. Prof. Owens chose as his subject "Electricity as a Factor in Modern Development." At the outset he referred briefly to the relation of the world's material and social progress to the work of the engineer—the man who economically converts the materials and forces of nature to useful and social ends. A single invention—the steam engine—had made more history in its short life than half the world's rulers. By the introduction of electric traction, not only had the sanitary conditions of our cities been improved, but healthy country homes had been substituted for the overcrowded tenement. Electric traction was not dangerous at higher speeds than is possible with horses, and the small cost of electric operation permitted of low fares being charged. The effect of rapid transit on urban architecture was also plainly seen.

In regard to electric power for industrial purposes, Prof. Owens said that he thought the change from older methods of factory driving to the present one of using electric motors had a distinct and elevating influence upon the character of the men employed. So scrupulously clean, cheerful and healthy had many modern shops become, that positions in them are eagerly sought by persons of both sexes of genuine culture and refinement. For example, the Weston Electrical Instrument Company, of New Jersey, were erecting a new shop for the manufacture of their famous instruments, in which not only are manual operations reduced to a minimum, and a pure sunlight effect maintained by skilful coloring and the intelligent use of electric lights, but the very air the employees breathe is first mechanically cleansed of every germ and dust particle it contains.

The question of the place of engineering in the coming university was dealt with. The speaker said that just as a general knowledge of science had become to be considered an essential in every course intended to afford a liberal education, so a general knowledge of the applications of the science would likewise be regarded. In other words, the broad principles of engineering would be included in every university course, and the special branches would be taught in graduate technical schools. But this would not come immediately—not until the supply of engineers more nearly equalled the demand for them, for only then could they be expected to spend more than four years in preparation for their work. For the present, then, electrical as well as other special branches of engineering must be conducted as undergraduate work, but so rapid have been the advances in the development of electricity, and so vast are the facilities for experiment possessed by the larger manufacturing companies, that the school is in general behind the factory. Consequently, every effort must be made to keep in close touch with best current practice. This it would be sought to accomplish in two ways—first, by equipping the electrical laboratories with the best facilities for investigation that could be obtained, most of the machines upon which tests are to be made being supplied by the manufacturing companies, as different new types are developed; and, secondly, by having practical engineers, engineers of the better electrical manufacturing companies, and others engaged in special work, deliver lectures on special subjects from time to time.

Prof. Owens said that few, if any, schools of electrical engineering were more happily situated than McGill. With the splendidly equipped factories of the Canadian General Electric Company at Peterborough, the Royal Electric Company at Montreal, and the magnificent water power developments at Lachine and Chambly, all within easy reach, the student would quickly learn the bearing of his subject upon the commercial and industrial interest of the Dominion, and it was the speaker's highest ambition that the splendid water powers of Canada should be guided into useful channels largely by graduates of McGill University.

Prof. Owens then returned to his original subject, and traced in more detail the developments in the several branches of electrical work. His remarks in this connection are given below in full:

ELECTRIC LIGHTING.

Sir Humphery Davy, with a battery of copper zinc elements, gave us the electric arc in 1810, by passing a current of electricity between the ends of carbon pencils held a small distance apart in air, but the generation of electricity by chemical means was then, and still is, too expensive for commercial use. It was not until after the discovery of the principle of the dynamo by Henry in 1830, and Faraday in 1831, that the way was opened for the general application of the most beautiful and easily managed of all forms of physical energy.

Coupled with the steam engine and water wheel, the dynamo converts the solar energy of our coal fields and waterfalls into a subtle and powerful force, whose applications are literally without number.

Unaffected by gravity or temperature, capable of indefinite subdivision and highly efficient conversion, and requiring the simplest of all means of conveyance—a stationary metal conductor—no limit can be put upon the use of electric power.

By 1870 the dynamo machine might be said to have reached a commercial form, but the problem of electric lighting was not solved until 10 years later. On February 5th, 1880, Mr. Edison filed an application for a patent on a system of electric lighting involving the use of high resistance electric lamps, arranged in multiple circuit across the terminals of a low resistance dynamo, solving by this combination the then serious problem of the subdivision, as it was called, of the electric light.

In September, 1882, the Edison Electric Illuminating Company of New York, started their Pearl street central station, to supply current on a commercial scale to the down-town or business districts of the city, and within the next few years about this old station were worked out many of the problems of central station practice.

So rapidly were the advantages of the incandescent lamp appreciated for interior lighting, and the electric arc for street illumination, that in less than a single generation from fifteen to twenty million incandescents and nearly half a million arcs are now in use in a single country—the United States.

In the early days of the industry when the problems of insulation and distribution were imperfectly understood, it was necessary to use low electric pressures and to place the central station close to the district to be supplied, but now that we have become familiar with pressures of ten, twenty, thirty and forty thousand volts, and the possibilities of alternating currents for transmission and distribution are better known, the station may be located well outside the limits of the average city, feeding into suitable substations wherever current is required. This means both a great economy in the cost of generation and the absence of the familiar smoke nuisance.

The most notable example of this practice of concentrating all generating machines in a single plant at a distance from the districts to be supplied, is that of the Third Avenue Railway Company, of New York. They are now installing the largest steam electric plant in existence, consisting of sixteen 6000 horse power dynamos, having a combined capacity of nearly 100,000 horse power, the equivalent of more than a million 16 candle power incandescent lamps. The station will be situated on the upper end of Manhattan Island, by the East River, and will distribute current by underground conductors, at a pressure of 10,000 volts, to sub-stations in all parts of the city. From the sub-stations current will be supplied for surface and elevated railways, electric lighting, motors, etc. Aside from the economy affected, this arrangement will have a tremendous effect in purifying the atmosphere of New York. But no such scheme is necessary here.

Happy, and thrice happy, should the people of this city be, because of the magnificent water power that is being developed at her very gates. Within easy reach of Montreal there is more hydraulic power than in the whole of Switzerland, and when fully developed and electrically applied we should have here the electric city of the Dominion. But as brilliant as have been the advances in electric science, we are still far short of what we hope the future holds.

CONVERSION OF ENERGY.

The two engineering problems that excite most interest to-day, are the efficient conversion of the energy of fuel into electric energy, and the conversion of electric energy into light, without accompanying heat. The steam engine converts only from five to ten per cent. of the chemical energy of coal into mechanical power, while the dynamo converts from ninety to ninety-five per cent. of the mechanical power it receives into electric power. In point of efficiency the dynamo is practically perfect, but all therma.

engines are subject to laws which under working conditions sadly limit their efficiency. Therefore, the effort is being constantly made to convert the chemical energy of carbon directly into electric energy without passing through the form of heat, a process essentially similar to the conversion in the ordinary zinc-copper battery, but, so far, no practical carbon battery has been produced. Indeed, it is doubtful if the art of government is sufficiently far advanced to withstand the social strain that such a revolutionary invention would produce. It would mean unlimited power at practically no cost, and would occasion industrial and social changes beside which those produced by the steam engine would dwindle to a vanishing point.

The efficiency of the incandescent lamp, though somewhat improved in late years, is still extremely small—only some three per cent.—the major portion of the electric power supplied being dissipated as radiant energy of a wave length too great to be appreciated by the eye.

Vacuum tube lighting, at high frequencies and high potentials, promises something, but the results so far obtained have not been all that was anticipated.

If our modern lighting apparatus could be brought to the efficiency of that of the glow worm and fire fly, the consumption of a few tons of coal per hour would light the world.

ELECTRIC POWER.

If a coil of wire is made to revolve between the poles of a magnet, a current of electricity will be generated in the wire, and conversely, if a current of electricity is sent through the coil from an external source, it will tend to move. In the one case we have a dynamo, in the other a motor. By different arrangements of magnets and different groupings of conductors, all the many types of electric machinery now in use have been evolved, but an inspection will show that modern dynamos and motors consist esentially of but two parts ; a stationary element, and an element having a pure rotary motion. This is the acme of mechanical simplicity, and when other features of the electric motor are considered, its small weight for a given output, the absence of noise, heat and odor, its ability to operate in any position, and under any atmospheric conditions, we are justified in thinking that a more perfect source of power could hardly be conceived.

Power distribution by electric motors, though first developed in conjunction with electric lighting, not only now exceeds many times the electrical interests, but has become one of the largest commercial enterprises of the globe. In 1898 more than a million horse power in electric motors was employed in America in street railway transportation alone, conveying, by a recent estimate, more than three billion passengers, and earning something like $125,000,000. These same railroads employ an army of 200,000 men, and represent an invested capital of from one to one and one-half billion dollars.

When we further consider the aggregate capacity of the thousands of motors employed in the distribution of power for other than traction purposes—in machine shops, cotton mills and sugar houses, in printing, pumping, hoisting, and ventilating, on modern warships for steering, handling ordnance, etc., to say nothing of the apparatus used in the transmission of power, as distinct from power distribution—we begin to form some adequate idea of the influence of this new agent.

Before the invention of the steam engine, waterfalls were of first importance as sources of power, and usually attracted settlements about them, but after Watt's discovery and Stephenson's application to the locomotive, it was found more convenient to transport the new source of power—fuel—to different established centres of population, instead of moving the centres of population to the sources of power. With the advent of electricity, however, not only have water powers acquired a vastly increased value by reason of the ease with which their energy can be economically transmitted over great distances, but electrical methods of distribution have in some cases actually superseded the railway for fuel energy transference, a case in point being the recently established plant of the Colorado Springs Power Company, for the transfer of the energy of coal from a low geographical level to a higher one without the necessity of overcoming gravitational forces.

The first experiment to reveal the astonishing possibilities of electric power transmission was made in 1891. In that year some 200 horse power was transmitted over a wire, roughly one-tenth of an inch in diameter, from Lauffen to Frankfort-on-the-Main, a distance of 108 miles, with a total loss in transmission and conversion of less than 30%, and this with an electric pressure not so great as will be used between Chambly and this city.

About the same time, plans were in preparation for harnessing the mightiest of all Nature's water powers—Niagara Falls—and a commission appointed to consider methods, including, among other distinguished scientists and engineers, Lord Kelvin, of Glasgow, and Professor Unwin, of London, after carefully considering all known means of power transmission, unanimously adopted electricity. To-day, about a mile above the falls, some 50,000 horse power is continuoulsy flowing from half a score of huge electric spinning tops. No feat of modern engineering has been watched with greater interest than this, and none more successfully conducted.

Though time does not permit me, nor would you find it of interest to go into details, I may mention that the power of Niagara has been estimated at about 7,000,000 horse power—greater probably than the physical force the whole human race is capable of continuously exerting. At present some 250,000 horse power is to be developed on the American and Canadian sides, or about 5 per cent. of the total power available—not enough to perceptibly diminish the flow over the falls. However, should the whole be utilized, leaving the rocky river bed dry and bare, we should but be substituting a wonderful cataract of etheric energy for the splendid flow of gravitational matter so justly famed. Which spectacle would present greater beauty would depend upon the individual.

To those who trace in imagination the course of a beam of sunlight, as it buries itself in the ocean, rises in cloud, and falls again in grateful shower over grain field and vineyard, filling brook and swelling river, and finally tumbling through mighty turbines and silently streaming from the polished slip rings of stately dynamos, bursting again into wholesome sunlight, to brighten the homes of hundreds, the substitution would but be the completion of a full cycle of usefulness and beauty. From either standpoint, however, Canada is fortunate, for she has water power enough and to spare. Some of this is already being splendidly developed, but much will not be needed for many years.

Among the best examples of electric transmission in the world are the plants at Lachine, Chambly and Hamilton. The latter plant started in September last, and is now transmitting some 2,500 horse power thirty-five miles, at the enormous pressure of 22,500 volts. The two former I suppose most persons in Montreal have had the pleasure of seeing.

The question is often asked, will electricity eventually supersede the locomotive on the present steam railroads? I may reply that careful estimates show no economy of electricity over steam for the handling of heavy freight traffic where the number of trains operated per day is small, but for passenger service, where trains must be operated at frequent intervals on small headway, the advantage is with electricity, and it is probable that because of the smaller cost, as well as increased speed, such cities as New York, Baltimore and Washington will be connected by through lines in the near future.

It is also of interest to inquire as to the probable limit of economical power transmission by electrical means. In reply to this I may say that Lord Kelvin, after an inspection of the Niagara plant in 1897, is quoted as placing the limit at about 300 miles.

At Snoqualmie Falls, Washington, there is now being installed a 6,000 horse power plant, to supply power to the cities of Seattle and Tacoma—one 31 and the other 45 miles distant. The pressure used is 25,000 volts. This voltage, though perhaps the highest in commercial use for so large an amount of power, is by no means the limit of practicable electric pressures, small amounts of power being transmitted commercially at pressures as high as 40,000 volts, and to distances of 85 miles. Recent experiments show that the leakage losses in a well constructed transmission line are practically negligible up to pressures of from 50,000 to 60,000 volts. Beyond this, however, such losses seem to increase rather rapidly.

It is estimated that about 200,000 horse power of electrical machinery is now in use on the American continent for transmitting the power of falling water.

TELEPHONE AND TELEGRAPH.

The principle of the telegraph was discovered by Prof. Joseph Henry, in 1829, and first practically applied by Morse in America and Wheatstone and Cook in England. The first telegraph line in America was erected between Baltimore and Washington in 1844, and the first message—"What hath God wrought"—is ever recalled with increasing force, as we contemplate the vast network of wire and cable that now forms the nervous system of the commercial and political world. For a long time the simple Morse system of telegraphy was the only one in general use in America, and similarly the single needle system in England, but as these became inadequate to the volume of business requiring to be done, other and more rapid systems were developed.

The "duplex" system, by which two messages can be sent in opposite directions at the same time over the same wire, appeared in 1858, but did not come into general use until in the early seventies. Later, in 1878, Edison brought out his "quadruplex," by which four messages can be simultaneously transmitted over the same wire without interference. Of late, the Delaney "synchronous multiplex" has taken a prominent place, but without doubt the greatest advance that has been made for many years in land telegraphy has occurred in the past year, and is due to Prof. Henry A. Rowland, of Baltimore. He has brought out a "multiplex printing telegraph," by which sixteen messages per minute, of twenty words each, may be sent over a single wire by operators skilled only in the use of the typewriter, the messages being automatically recorded, not in cipher, but in ordinary type, at each end of the line. I had the pleasure of seeing his apparatus, which is a marvel of mechanical beauty, in successful operation a few weeks ago, over artificial lines varying from 500 to 1,000 miles in length. A modification of his system, adapted to automatic sending, will transmit from 3,000 to 4,000 words per minute. What this means may be seen by remembering that at this rate the contents of a New York daily might be transmitted to Montreal in less than an hour.

But, notwithstanding these devices, by which the carrying capacity of a single wire is multiplied many times, efforts are continually being made to do away with wires altogether, and to transmit messages by setting up electro-magnetic waves at different sending points, and using suitable detectors as receivers. At the transmitting station, by means of a key and suitable sending mechanism, a series of electro-magnetic waves are projected into space and travel in all directions with the speed of light. Falling upon a metallic collector connected to a tube containing fine conducting particles in loose contact, the particles are found to cohere and to have an increased electric conductivity. This change in their conductivity is readily used to register a signal. Other forms of detectors or receivers have also been devised, and some of you probably remember the beautiful magnetic detector invented by Prof. Rutherford, shown by him in the McDonald Physics Building some months ago.

Wireless, or space telegraphy, as it is sometimes called, though partially successful up to distances of about twenty miles, will not, in its present form, supersede the older methods. It is, however, finding a limited application in England, particularly in their coast signalling system, and Mr. W. H. Preece, in a recent address before the Institution of Civil Engineers, states that a system of his own is now in use by the Post Office and War Departments of the British Government.

The extent to which the telegraph in its ordinary form is used may be roughly gathered by recalling that in the United States there are more than a million miles of telegraph wire, strung on over 200,000 poles, and connected to about 25,000 offices. The number of messages annually transmitted by a single company has already reached some 70,000,000, resulting in a gross income of over $25,000,000.

The telegraph and cable systems of the British Empire employ, according to recent statistics, about the same length of wire, 1,111,000 miles, and transact a proportional business.

No great advance has been made in cable working since Lord Kelvin devised his mirror galvanometer and siphon recorder, except the application of duplex working, by which the capacity of cables has been practically doubled, but a great number of improvements in detail have been effected and many new cables laid, until now some 150,000 miles of ocean cable are in use, costing roughly about $150,000,000, and requiring a fleet of over twenty ocean-going vessels to keep them in repair.

Bell obtained his fundamental telephone patent in 1876, and a number of important improvements were made shortly after. The first Bell instrument was used both as a receiver and transmitter, but the carbon transmitter and induction coil made their appearance within the next year. Since then a vast amount of work has been done in perfecting details, and now telephonic communication is daily carried on between points from 1,000 to 1,800 miles apart with perfect clearness.

In the United States there are considerably over a million telephone instruments in daily use, and each day more than three million connections are made. In England about 150,000 miles of telephone wire are in use, and the number of messages per year has reached something over eighty million.

OTHER APPLICATIONS.

The most marked feature of electrical development in the past year has been the astonishing growth of the electric vehicle business. Within a few months, orders amounting to $15,000,000 have been received by American manufacturing companies from Europe, and it is expected that the entire cab system of Paris will substitute electricity as a motive power before the end of the present year. Cleanliness, increased speed, and the easing of the congested traffic conditions in our crowded business districts are obvious results, but I also look for the betterment of our country roads, even to a greater extent, from the use of the automobile than the bicycle. The old days of post roads and country inns will be revived, but electricity instead of horses will be the motive power. Indeed, a company has recently been organized in Paris to carry out this very idea.

The applications of electricity in electro-chemical processes and in the refining of metals is also most marked. In 1897 the output of German electrolytic alkali works alone was 20,000 tons, and in the past year it is estimated that more than 300,000,000 pounds of copper were electrolitically refined. Some 8,000,000 pounds of aluminum are also annually produced in the same manner, to say nothing of the various products of the electric furnace.

In hundreds of other ways electricity is playing a similar part. In agriculture, electrical methods of stimulating plant growth have passed the experimental stage. In medical practice it has become indispensable. In domestic life the electric call-bell, chafing dish and fan motor bring a measure of comfort even to bachelor quarters. Indeed, no bounds can be placed upon this spirit of the 19th century, that comes

"To answer our best pleasure ; be't to fly
To swim, to dive into the fire, to ride
On the curl'd clouds."

NOTES.

Last month it was stated that "things would soon quiet down with construction men, and supply dealers would be correspondingly affected." This is exactly the status of business at present in Montreal, with, however, every indication of a brisk spring trade at the opening of navigation.

The Laurie Engine Co., of this city, have just completed a new 500 h.p. engine for the Winnipeg Electric Street Railway. This engine is of the vertical cross-compound Corliss type, provided with tail rods and a shaft governor. The cylinders are respectively high pressure 18 inches, and low pressure 36 inches in diameter, with a common stroke of two feet. The fly wheel is ten feet in diameter and weighs about fifteen tons. The working steam pressure is to be 125 lbs. per square inch, and the speed 120 revolutions per minute.

The Lachine Rapids Hydraulic & Land Co., of Montreal, having suffered interruptions to their lines, engaged detectives to discover the miscreants. As a result a charge was laid against Alexander Daoust, under article 492 of the Criminal Code, for attempting to damage wires used for electric lighting. The manner in which the interruption was caused was by throwing iron hoops so that they would rest on both wires, thus producing a short-circuit. Daoust was tried before Judge Desnoyers, who imposed a fine of $5.00 and costs, serving to show that the law punishes any interference with electric wires.

The death is announced of Mr. F. H. Badger, jr., son of Mr. F. H. Badger, city electrician of Montreal, at 35 years of age, from pneumonia, brought on by an attack of la grippe. Deceased was for some time in charge of the contruction department of the Royal Electric Company, of this city, later taking charge of the lighting department as superintendent. He left the Royal Company some years ago to take charge of the Montmorency Power Company's plant at Quebec, succeeding the late Mr. Mohr. Lately Mr. Badger resigned his position with the Montmorency Power Company to accept a position in Washington, U.S.A.

Motor-vehicles as sold in the United States will be about as useful in the city of Montreal as a wheel-barrow. It would appear that the cities in the United States must be fairly level, judging by the grades which the auto-vehicles are guaranteed to ascend. As Canadians are beginning the manufacture of these popular articles, they will not be likely to forget Montreal, more especially if any of the members of their company have had occasion to walk up-town on a hot summer's day. If they have driven in Montreal, they will also remember that the rule of the road is 'to the right,' hence the controller handle would be of more use arranged 'right'-handed.

The upper pumping station of the Montreal waterworks is situated in rear of the McGill College grounds, near the main reservoir. The McGill authorities claim that smoke from the stack of the station damages their instruments. They also contend that leaks from the reservoir percolate down into their grounds and undermine the foundations of certain buildings, which seems quite probable, as it has been known for some time that the reservoir was defective. As a means of overcoming the smoke nuisance, the authorities of McGill have suggested that electricity be utilized for pumping purposes, the power to be obtained from the Lachine Company or the Royal Electric Company. Thev have offered to submit a scheme if remunerated for their work by the council. That any change will be made is extremely improbable, as the contract for a new boiler has recently been given to Mr. John McDougall.

SERIES ARC LIGHTING.*

By Wm. A. Turbayne, E.E.

Although the arc light first made its appearance about the beginning of the present century, it is only within the last quarter of a century that it has become generally adopted as an illuminant. About the year 1802, an Englishman, Sir Humphrey Davy, conceived the idea of opening an active electric circuit between two points of carbon. He had at his disposal some 2,000 cells of a simple primary battery, which he connected in series, and from the extreme terminals he brought wires to the ends of which were connected small pieces of charcoal. These he touched together and afterwards drew apart, and in so doing the current bridged the gap which was made, appearing as a flame having powerful heating properties and causing the charcoal tips to glow to an intense whiteness. Thus appeared the first true arc light.

The charcoal points were evidently held in a horizontal position, as the stream of vaporized carbon appeared in the form of an "arch," being impelled upwards in the centre by the ascending currents of air; from this phenomenon we derive the name "arc" light. About thirty years after this discovery of Davy's, one Michael Faraday discovered and promulgated the principle of electro-magnetic induction. He found that when a steel bar magnet was passed through a coil of wire properly arranged, a current of electricity was momentarily induced in the coil, which manifested itself similarly as the current from a primary battery, and this important discovery soon led to the development of the dynamo machine for producing powerful currents.

Previous to the introduction of these dynamos the arc light was seldom seen outside the laboratory, the expense and annoyance, coupled with the use of acid batteries, prohibiting its more extended adoption. With the advent of the dynamo, however, renewed interest was taken in the development of the arc light; mechanisms called lamps were devised for feeding the carbons together as they wasted away, and improvements were introduced into the current generators so that an uninterrupted light could be maintained for considerable periods. Even at this time, however, the usefulness of the new light was limited, as it was found that the feeding of the lamp so affected the current in the line that only one lamp could be operated on a single circuit, and it was only in certain isolated cases, such as in lighthouses, that the light became of value.

This was the condition of affairs until some forty years later, when in 1875 Chas. F. Brush, of Cleveland, and others, discovered the principle of differential regulation, which made the operation of several lamps on one circuit and machine possible, and made each lamp an independent unit as regards its feeding properties.

It is not our intention in this paper to follow the art of arc lighting from the date of its inception and to successively note the advances which have been made in bringing this method of illumination up to its present state, but to offer a brief exposition of the cardinal principles involved, and to shortly describe the functions of the mechanisms employed in a modern system of series arc lighting, in which a direct current of constant value is employed, a system which has been developed since the introduction of the differential lamp of 1875.

Such a system virtually comprises a current generator or dynamo, a number of arc lamps and an arrangement of conductors interconnecting the whole in such manner that the current on leaving the dynamo enters the first lamp and thence passes to the next, and after having successively traversed all the lamps in like order, returns to the dynamo, the path of the current therefore being in one continuous circuit, within which the total electrical energy produced by the generator is expended.

If we take a pair of carbon rods and introduce them into an active electric circuit, as above, no light will be emitted until a separation of the carbons takes place, and we find that, with the current strengths adopted in practice, a separation of approximately one-eighth of an inch gives the best results, as being free from objectionable hissing or flaming. Such an arc requires for its maintenance an electro-motive force or pressure of about 45 volts, which represents an energy of something over ½ horse power. This energy is expended, in part, in overcoming the resistance of the arc gap, but the greater part appears in the form of heat, and the resulting temperature is so concentrated and intense as to cause a vaporization at the surface of the positive carbon, which in the process is brought up to a highly incandescent state, this being in reality the source of light. This vaporization and a combustion of the carbons is accompanied by a gradual wasting away and consequent shortening of same, and in order, therefore, to maintain an uninterrupted light, means must be found for feeding the carbons together at a rate proportional to this consumption.

An arc lamp, therefore, is substantially a mechanism for initially separating the carbons a predetermined distance, and for further maintaining them at this distance during continued operation. In studying the arc lamp we will not touch on the innumerable mechanical devices, such as racks and pinions, brake wheels, clutches and bands or chains, which are employed with the one view of gripping and releasing the carbon under the control of the actuating magnets, but we will describe the action of an ideal differential lamp, such, in fact, as may be taken as a representative of the types in extended use.

The carbons are separated by an electro-magnet in the main circuit through which the whole current passes, while the feeding is effected by another electro-magnet acting in opposition to and tending to overcome the lifting action of the first. The second magnet is provided with a high resistance winding of fine wire and is connected as a shunt across the carbons, and therefore exerts a greater or lesser influence, accordingly as the carbons are more or less widely separated; therefore, as the carbons are consumed the arc increases in length, and coincidently the second magnet opposes the action of the first, until finally it overpowers it and allows the carbons to feed forward. In practice so fine a balance is obtained between these two magnets that the carbons are continually feeding forward in imperceptible degrees.

There are, of course, numerous modifications of this principle introduced into different lamps, but, nevertheless, their electrical actions are similar, inasmuch as the separation of the carbons is brought about by the action of the main current itself, while the feeding is accomplished by the action of a circuit derived from this and having as terminals the upper and lower carbons.

We may here state that the illuminating power of an arc lamp varies with the electrical power which is expended within it. This electric power, expressed in watts, is the product of two factors—the electro-motive force or pressure and the volume of the current as expressed in the terms volts and amperes respectively.

We have seen that the function of the arc lamp is to look after one factor, viz., the pressure or volts across its terminals; consequently, in order to produce an unvarying light, we must keep the other factor of current volume constant.

The functions, therefore, of the generator or dynamo is to furnish a current of constant strength, and, as the lamps are connected in series, and as each demands some 45 volts as explained, it must operate at a pressure sufficient to maintain the number of lamps for which it was designed to operate, together with sufficient marginal pressure to overcome the resistance of the copper lines connecting same.

An arc lighting dynamo, like most other dynamos, consists essentially of an arrangement of copper conductors wound over an iron core and rotating within the influence of the poles of a powerful electro-magnet, but, as contrasted with constant pressure dynamos, which include those used in operating incandescent lamps in multiple and those used in furnishing current to stationary and street railway motors, it must possess peculiar properties, which are required to adapt it to the running of arc lamps on series, and notable among which is that a fall of current below the normal strength must be accompanied instantly by a rise in voltage, and likewise with an increase of current the voltage must fall. We may here state that while the function of a constant pressure dynamo is to keep the electro-motive force or pressure factor constant while the current is variable, the constant current or arc dynamo, on the other hand, must keep the current factor constant while the pressure is variable. In such a machine the magnets are series wound, and the energizing windings are traversed by the full current passing through the circuit of lamps. The iron magnet cores are so proportioned as to be magnetically saturated, that is, are worked to such a high degree of magnetization as to be insensible to slight changes in the strength of the current which energizes them.

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* Paper read before the Hamilton branch Canadian Association Stationery Engineers.

On the other hand, the rotating armature is wound with a great number of turns of wire, and in reality constitutes a powerful magnet, which is sensitive to current changes, and which meanwhile reacts against and partially controls the magnetic field, which induces the current within itself.

As, therefore, the switching off of a lamp, or the feeding of several lamps at once, would cause the current to rise, the armature magnetization would increase perceptibly, while that of the field magnet would not do so; the former would, therefore, so react against the latter as to reduce the effective magnetic strength, and the voltage therefore would fall; the reverse action would likewise take place should one or more lamps be switched on. In order that this inherent regulating property will be effective over the whole range of the machine, automatic current regulators are employed, which, by moving the collecting brushes around the commutator, or by adjusting the field strength, so adjust the electro-motive force, and incidentally the current strength, as to meet the conditions of the outside load, and further assures sparkless operation at the collecting brushes.

The power required to drive an arc dynamo will be in proportion to the number of lamps burning at any time, and will vary as the number of lamps in operation. As we have stated that the electric power is the product of the current volume and the electro-motive force, and as the former factor is constant, the power delivered will vary, therefore, as the latter factor, which varies only as lamps are added to or withdrawn from the circuit.

Arc dynamos, unlike constant pressure dynamos, do not necessarily demand the refinements in speed governing in the mover which drives them, as the inherent regulation of the machine itself will look after any such irregularities as are met with in practice; and in fact, with the brushes locked in a fixed position, constancy of current during change of load may be obtained by varying the running speed only.

There are other accessories, such as automatic lamp cut-outs, which ensure continuity of the circuit should a lamp be defective, lightning arresters for protecting the lines and station apparatus, and loop switches for controlling groups of lamps, which we cannot now cover in detail, and which, although essential to the satisfactory and safe operation of such a system, yet are not necessary to the production of the light itself, the generator and lamps being the indispensable adjuncts of a series arc lighting system.

MARITIME ELECTRICAL ASSOCIATION.

Arrangements are being completed for the next convention of the Maritime Electrical Association, which will be held in the city of Halifax, N.S., probably about the 18th of April. Further particulars will be given in the next issue of the ELECTRICAL NEWS.

Mr. J. E. Askwith, of Ottawa, is endeavoring to organize a company, to be called the Compressed Air Transmission Company of Ottawa, for the purpose of transmitting and supplying compressed air in the city of Ottawa and elsewhere.

SPARKS.

Mr. W. J. Fletcher, of Markham, Ont., has disposed of his electric light plant to the corporation.

It is again reported that the Galt and Hespeler Street Railway will be extended from Preston to Berlin.

The Board of Police Commissioners of Toronto have decided to test an ambulance propelled by electric power.

The Ontario Legislature has granted authority to the London Electric Company, Limited, of London, Ont., to increase its capital stock to $500,000.

Mr. C. A. Chant, B.A., lecturer on Physics at Toronto University, recently delivered a public lecture, with demonstrations, on ' Electric Waves.

The annual meeting of The Canadian General Electric Company was held in Toronto recently. All the old directors who were eligible were re-elected.

The electric light plant at Shubenacadie, N.S., has changed hands. It has been purchased from its former owner, R. C. Ervin, by John Christie, of Dartmouth.

The Ottawa Suburban Electric Company, of which Mr. Geo. E. Kidd is solicitor, is asking for a charter to build an electric railway to Shead's Mills and Windermere.

Messrs. Cunliffe & Ablett, of Rossland, B. C., have placed an order with the Canadian General Electric Company for two of their standard 50 h.p. three phase induction motors.

The Department of Railways and Canals has purchased from the Canadian General Electric Company additional generating apparatus for their improvements on the Sault canal at Sault Ste. Marie, Ont.

The Private Bills Committee of the Ontario Legislature has passed the bill authorizing the town of Goderich, Ont., to issue $25,000 of debentures to complete the water works and electric light plant.

The annual meeting of the Guelph Light & Power Company was held recently, at which Mr. D. Guthrie was re-elected president, Mr. Richard Mitchell vice-president, and Mr. John Yule general-manager.

The annual statement of the Halifax Electric Railway shows that the gross earnings in 1898 were $197,830, an increase of $4,450. The operating expenses were $113,081, against $112,570, an increase of $511.

The city council of Montreal have accepted the tender of John Macdougall, of the Caledonian Iron Works, for furnishing a boiler for the water works, at the price of $5,975. Other tenderers were: Geo. Brush, $5,680; Babcock & Wilcox Co., $6,410.

The town council of Pembroke, Ont., and the Pembroke Electric Light Company have not reached an agreement regarding electric lighting, and it is possible that a by-law may yet be submitted to the ratepayers to raise money to install a municipal plant.

The Light, Heat & Power Co., of Lindsay, Ont., is making some extensive additions to their power plant, and have purchased a large 500 volt multipolar power generator from the Canadian General Electric Company for the purpose of meeting the many demands for power.

The Richelieu & Ontario Navigation Company are equipping their new boats in the most modern manner, and have purchased from the Canadian General Electric Company two of their standard direct connected 500 light generators, with Ideal engines and marble switchboards.

The city of Sherbrooke, Que., recently invited tenders for electric lighting, and has awarded the contract for five years to the Sherbrooke Gas & Water Company. The price for arc lamps, 7½ amperes, is $60 per lamp up to 100, and $50 per lamp for all over that number, four incandescent lamps to count as one arc lamp.

The annual meeting of the Cataract Power Company of Hamilton was held last month, at which the following officers were re-elected: President, Hon. J. M. Gibson; vice-president, James Dixon; treasurer, John Moodie; secretary, John Patterson. The company is now delivering 1,000 h.p. in Hamilton, and contracts are about to be closed which will double that amount.

As examples of unsuccessful municipal plants, it is pointed out that Xenia, O., paid $35,000 for its lighting plant, and sold it for $10,060, and made a contract with a private company; Gravesend, L.I., paid $120,000 for its plant, sold it for $30,000, and made a contract with a private company also; Grenville, S. C., found it could better afford to pay a private company $100 a light than to own its own plant.

The town council of Gravenhurst, Ont., is considering a proposition to raise $20,000 for a waterworks system and $10,000 for an electric lighting plant, and in response to a request, Orillia town council has offered to supply Gravenhurst with 100 horse power for the sum of $1,000 per year, the former municipality to pay the cost of line construction to Ragged Rapids, about ten miles distant. This price is for power delivered at Ragged Rapids.

The British Columbia Electric Railways Co., Vancouver, B.C., are making vast improvements in their railway development, and for the purpose of carrying out this work have purchased from the Canadian General Electric Company three C.G.E. 1,000 two-motor equipments, and four C.G.E. four-motor equipments, complete with controllers, resistances, etc. They have also, for their lighting plant, placed an order for a large 500 kilowatt alternator of the Canadian General Electric Company's type.

SPARKS.

Joseph Knox, Esq., of Stayner, has purchased from the Canadian General Electric Company a 700 light single phase alternating current dynamo.

The railway commissioners of the town of Port Arthur, Ont., have purchased a new Goldie & McCulloch boiler, for operating the electric railway.

Mr. Thos. Tompkins, of Brockville, Ont., has had plans prepared for a new hotel to be erected in that town, and which will be equipped with an electric light plant.

The Montreal Novely Co. are lighting their factories at Louiseville, P.Q., and have just installed an electric plant for this purpose, purchased from the Canadian General Electric Company.

The city council of Winnipeg seems to be in favor of a civic electric lighting plant, and it is probable that the question will again be submitted to the ratepayers, notwithstanding that it was defeated a few months ago.

A dispatch from Buffalo states that the Niagara Falls and Lewiston railroad, otherwise known as the Gorge Road, has passed into the hands of a receiver. This is said to be due to the heavy losses from damage suits.

The town of Brockville, Ont., is considering the question of installing a municipal electric light plant. It is not expected that any definite action will be taken during the present year beyond obtaining estimates of the probable cost.

The Alberta Railway & Coal Co., of Lethbridge, N.W.T., is installing an electric outfit, and has purchased from the Canadian General Electric Company a 150 light direct current generator, with the necessary supplies, for lighting their mines.

Mr. John Mullin, formerly connected with the Ottawa Electric Railway Company, is now in Port Elizabeth, South Africa, where he is inaugurating a new road under the auspices of the British Canadian Electric Company, of London, Eng.

The Guelph Street Railway Co. have recently purchased from the Canadian General Electric Company one of their standard 110 kilowatt 6 pole railway generators. This has been installed, and is said to be much admired by all who visit the power house.

The town of Whitby, Ont., is about to make arrangements for its electric lighting. It is reported that a contract for five years with Madill Bros. will be recommended by the Fire and Light Committee.

The Canadian General Electric Company have closed a contract with the London Electric Co. for one of their standard 300 kilowatt revolving field type single phase generators, which is the second machine of this type recently purchased by the London company.

This is not the season for mosquitoes, but an inventor of Angouleme, France, is ready to welcome them with a novel thrill. He has invented a mosquito netting, which is charged with electricity, and the moment an insect touches it down the insect drops, shocked to death. Next!

The Canadian General Electric Company have received an order from the Toronto Railway Co. for a third large generator; this will be of the direct connected type, similar to the two already in operation, and will have a capacity of 850 kilowatts, operating at 85 revolutions per minute.

It is announced that a Toronto syndicate have instructed Messrs. Bond & Smith, architects, to prepare plans for a large office building to be erected on Terauley street, opposite the new city hall. The building will contain a private telephone system, and will be equipped with an electric lighting plant.

The Lake Erie and Detroit River Railway, of Walkerville, Ont., are equipping their magnificent steamer "Flora" electrically, and have contracted with the Canadian General Electric Company for a lighting generator, in connection with an Ideal engine, marble panels, and the wiring of the steamer throughout.

The various local associations of marine engineers in Canada have decided to amalgamate, under the name of the National Association of Canadian Marine Engineers. This step was decided upon at a meeting held in Toronto on March 9th. The first convention will be held in Montreal shortly after the close of navigation.

Mr. A. A. Dion recently delivered a public lecture in Ottawa on "Electricity as Applied to Arc and Incandescent Lighting." Mr. Dion showed how electricity was generated in a dynamo and how transformed in distribution by means of transformers, and explained the construction and operation of arc and incandescent lights.

The Montreal Street Railway Company are now testing a street car recorder, similar in principle to the ticker used in the brokers' offices to record the fluctuations of the stock market. By attaching the instrument to any line a record is shown at the superintendent's office, and it can then be seen how many cars pass a given point in a given time.

The Peterborongh Light & Power Company have submitted to the Council of Ashburnham, Ont., a proposition for lighting the village, in which they agree to furnish power and light for the eleven arc lights now in use for a term of five years at the price of $50 each per year, burning from half an hour before dark till midnight for at least three hundred nights a year.

A bill to incorporate the Nova Scotia Electric Light and Heat Company has passed the legislature of that province. The company propose to light by electricity the whole Annapolis valley from a power station to be situated on the Gaspereau river. The estimated expenditure is placed at $400,000. The incorporators are: Dr. F. W. Borden, Minister of Militia, Ottawa; Dr. Allen Haley, M.P., Windsor, N.S.; J. W. Beckwith, C. O. Ross, F. W. Clarke and F. B. Wade, of Bridgewater, N.S.

The Kentville Electric Light & Power Co., Kentville, N.S., find that the demands upon them for light and power have been so great during the past year that they have been compelled to increase their capacity, and for this purpose have purchased two-45 kilowatt direct current generators from the Canadian General Electric Company, of their latest multipolar type.

The Quebec District Railway, Light & Power Company will this spring build a new line of railway to connect with the old Quebec, Montmorency & Charlevois route at Montmorency Falls. When the system of this company is completed about 60 miles of electric road will be in operation. New cars for the company are now under construction by the Ottawa Car Company.

A. S. Bowen, Esq., of the Kemptville Milling Co., Kemptville, Ont., has purchased the plant of the Kemptville Electric Light Co., and is making some material changes in modernizing the apparatus. For carrying out this work, he has purchased from the Canadian General Electric Company one of their standard new type 60 kilowatt single phase alternators, with necessary switchboard and instruments.

The town council of Picton, Ont., has engaged Mr. Roderick J. Parke, E.E., of Toronto, to prepare plans and specifications for improvements and extensions to the municipal electric lighting plant. Tenders for an alternator of 120 kilowatts capacity, transformers of a total capacity of 1,000 lights, slow speed engine of 125 h.p., and general supplies, such as weatherproof wire, insulators, cross arms, etc., are invited up to April 4th.

The corporation of the town of Barrie advertised for tenders for alternating current apparatus. The contract for 120 k.w. "S.K.C." two phase alternating current generator for power and lighting apparatus was awarded to the Royal Electric Company, of Montreal. The entire lighting and steam plant, which has been taken over by the corporation from the Barrie Gas & Electric Company, is being rebuilt and the capacity enlarged.

The Edison Electric Light & Power Co., of Springhill, N.S., are about to undertake the development of a water power, and invite tenders up to March 31st for the supply of generators, switchboard equipment, transmission line, extension of line in new district, wiring and necessary material for three thousand house lights, hydraulic machinery, and the construction of power house. The generators are to consist of two alternators of 75 k.w. each, with sufficient transformers. The president of the company is Mr. J. E. Simpson.

The Canadian General Electric Company have received an order from the T. Eaton Co. for one of their standard 130 kilowatt direct connected generators. This makes the fourth generator of this size which the T. Eaton Co. have purchased from the Canadian General Electric Company, in addition to one 75 kilowatt and one 25 kilowatt generator of the same type. The T. Eaton Co. are furnishing power from their electrical apparatus for operating all their manufacturing machinery and the lighting throughout the whole of their premises. The plant when finally completed will be the largest and most modern isolated plant in Canada.

It is reported in Buffalo that a deal has been consummated for the purchase by a New York and Philadelphia syndicate of the entire street railroad system of Buffalo and a number of suburban lines. The companies involved are given as: The Buffalo Railway Company, the Buffalo Traction Company, the Buffalo, Bellevue & Lancaster Railway Company, the Buffalo & Niagara Falls Railway Company, the Buffalo and Lockport Railway Company, the Niagara Falls Park and River Electric Railway Company (running along the river bank on the Canadian side), the Niagara Falls and Clifton Bridge Company, and the Lewiston & Queenston Heights Bridge Company. The capital of the syndicate is estimated at $25,000,000.

Mr. John R. Booth, of Ottawa, has entered into a contract with the Canadian General Electric Company for a large power transmission plant to be used in connection with railway shops at Ottawa. The power will be transmitted a distance of from three to four miles, at a pressure of 4,000 volts. The generating plant will consist of two 150 kilowatt revolving field three phase generators, together with the multipolar exciters and marble panels, with latest type instruments. At the receiving end for operation of the different departments, there will be installed three 100 kilowatt revolving field type 4000 volt three phase synchronous motors. The plant when completed will be a model in every particular, and Mr. Booth deserves admiration for being one of the first to recognize the advantages to be derived from a power transmission of this kind, where the power to be transmitted will be wholly for his own use.

A syndicate of Toronto capitalists, headed by Mr. J. A. Culverwell, electrical and mechanical financial broker, is reported to have purchased the Burleigh Falls water power, near Peterboro'. The purpose is to develop the power and transmit it to Peterboro' and Lindsay, twenty and thirty miles distant respectively. There is a head of twenty-five feet, and an estimated power of between three and five hundred horse power. The dam and power house will be located at the foot of Perry's Creek, at a point where the channel is so narrow that a concrete dam for the purpose can be built at a cost of about $5,000. The government canal dam will take the overflow of the spring freshets, while it is said that the peculiar situation removes all possible danger of interruption from anchor or frazil ice. At Lindsay Mr. Culverwell has secured the town lighting contract for ten years, and revenue for power and lighting amounting to some $15,000 per annum. The company will be capitalized at $200,000.

CONSOLIDATION OF ELECTRIC MANUFACTURING INTERESTS IN TORONTO.

The amalgamation has taken place since our last issue of the W. A. Johnson Electric Company and the Toronto Electric Motor Company, Limited, of Toronto. About one year ago the business of the Toronto Electric Motor Company was reorganized as a joint stock company, Mr. J. W. Thompson at that time purchasing an interest and combining with it the manufacturing business formerly carried on in Hamilton under the style of the Thompson Electric Company. Recently Mr. Thompson secured control of the entire business of the Toronto Electric Motor Company, and now this company and the W. A. Johnson Electric Company have amalgamated their manufacturing business under the style of the United Electric Company, Limited, with head offices at 134 King Street west, Toronto. Both factories will be operated at present, and arrangements are being made for a considerable extension of their manufacturing plants.

The officers of the new company are as follows: W. A. Johnson, president; J. W. Thompson, secretary and treasurer; J. Norman Smith, engineer in charge of works. The official staff of the company have had a long and extensive experience in electrical engineering and manufacturing, and being practical and technical experts, the success of the new company would seem to be assured. Mr. Johnson has since 1882 acted in the capacity as superintendent and electrical engineer, and for many years general manager of the Ball Electric Light Company, Limited, the first electrical manufacturing business established in Canada, and for the last five years proprietor of the manufacturing business of the W. A. Johnson Electric Company. Mr. Thompson was also on the staff of the Ball Company, and later had entire management of the Reliance Electric Mfg. Company. Mr. J. Norman Smith was formerly superintendent of the Ball Company, and for the past five years engineer for the W. A. Johnson Electric Company.

The United Electric Company will have a capital stock of $150,000, of which $100,000 is fully paid in, and $50,000 treasury stock. The company will manufacture a very complete line of apparatus, including automatic arc dynamos and universal arc lamps of enclosed and open types, direct driven and belted direct current multipolar dynamos and motors, bipolar motors and dynamos, inductor alternators (having inherent regulation) for lighting and long distance power transmission by polyphase currents, induction motors, etc. To these other lines will be added not heretofore manufactured by the respective companies in the consolidation. The Toronto Electric Motor Company have done a large Canadian business in bi-polar direct current motors of the single-field coil type.

The various agencies of both companies will be maintained and agents will be appointed where neither company is now represented. With the enlarged facilities for doing business, the company will be in a position to cater for all classes of electrical work.

A manager is wanted for the St. Thomas Street Railway. Applications are to be made to the president, Mr. J. H. Still.

The Bear River Electric Light Company, of Bear River, N.S., have decided to extend their system to Digby, which will necessitate increased equipment.

Messrs. Darling Bros., of Montreal, have just issued a new catalogue describing some of the special machines which they manufacture, and for which they are sole agents in Canada. These include, among others, the Webster vacuum feed water heater, the Moore steam pump, the Morse valve reseating machine, and the Nordberg governor.

SPARKS.

Messrs. Brown & Boggs, manufacturers, of Hamilton Ont., have decided to operate their factory by electric power, and are installing a 30-h.p. two phase "S. K. C." motor. Power for the same will be furnished by the Cataract Power Company.

The Brantford Gas Company, of Brantford, Ont., has a bill before the Ontario Legislature providing for an increase of capital stock to $200,000. It is understood that the company have in view an amalgamation with one of the local electric light companies.

The Canadian Development Company, of Victoria, B. C., have been building a steamer on Lake Bennett, Yukon Territory, and expect to have it ready for its trial trip by April 1st. The boat is lighted throughout by electricity; the plant being furnised by the Royal Electric Company, of Montreal, and consisting of one of their C. W. multipolar dynamos, direct connected to a horizontal ideal engine, this making a very compact and complete plant.

The Winnipeg Street Railway Company have been supplying the electric light and motor services from the same wires, but finding their capacity inadequate, announced their intention of changing the system and substituting new motors, placing the whole service in a more satisfactory condition. The cost of new motors was given as follows: 1-½ h.p. motor, $30; 2 h.p $35; 3 h.p. $42.50; 4 h.p. $50; 5 h.p. $60; 6 h.p. $70; 10 h.p. $80; 12 h.p. $100. Their customers, however, have not taken kindly to the proposal, and at a recent meeting passed a resolution against any change being made.

The Metropolitan Railway Company will erect a supplementary power house at York Mills to assist the generation at the large station at Bond's Lake. Concerning the improvements now being made by the company, the consulting engineer, Mr. W. T. Jennings, says: "Considerable additions are being made to the rolling stock. Although the company has the right to use steam, it will depend entirely upon electric power. The dynamos, the motors, and the rest of the machinery will be first-class in every particular. A special class of heavily equipped freight cars will be used, suitable not only for carrying very considerable loads themselves, but also for drawing other loads. If business warrants it, an electric locomotive of orthodox type will be purchased. These locomotives are of the Baldwin-Westinghouse pattern, are capable of drawing immense loads, and weigh from 22 to 25 tons. The passenger cars will be of the latest and best description, and of the style most suitable for the business of the Metropolitan Railway. The intention is to make the road first-class throughout for both passenger and freight business. It is possible that connections with the Grand Trunk Railway at Newmarket or Aurora and with the Canadian Pacific Railway at North Toronto will be made, but this will depend upon the probable results.

PERSONAL.

Mr. Geo. White Fraser, of Toronto, has been appointed by the Dominion Government to survey the boundary between British Columbia and the Yukon district.

Mr. Geo. Morrison, at one time a well-known manufacturer of engines and boilers in Hamilton, died in that city last month. Some years ago he was associated with Mr. J. H. Killey.

Mr. J. C. McLachlan, who recently disposed of his interest in the Toronto Electric Motor Company, is reported as having decided to engage in the manufacture of gasoline apparatus for horseless carriages.

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That there are more **Victor Turbines** in use supplying power for electric generators than any other, is due to the many points of superiority possessed by this Turbine.

FEATURES WORTH REMEMBERING—
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RECENT PLANTS INSTALLED:—Lachine Rapids Hydraulic & Land Co., Montreal, Que., 12,000 h.p.; Chambly Manufacturing Co., Montreal, Que., 20,000 h.p.; West Kootenay Power & Light Co., Rossland, B.C., 3,000 h.p.; Dolgeville Electric Light & Power Co., Dolgeville, N.Y.; Honk Falls Power Co., Ellenville, N.Y.; Hudson River Power Transmission Co., Mechanicsville, N.Y.; Cataract Power Co., Hamilton, Ont.

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CANADIAN

ELECTRICAL NEWS

AND

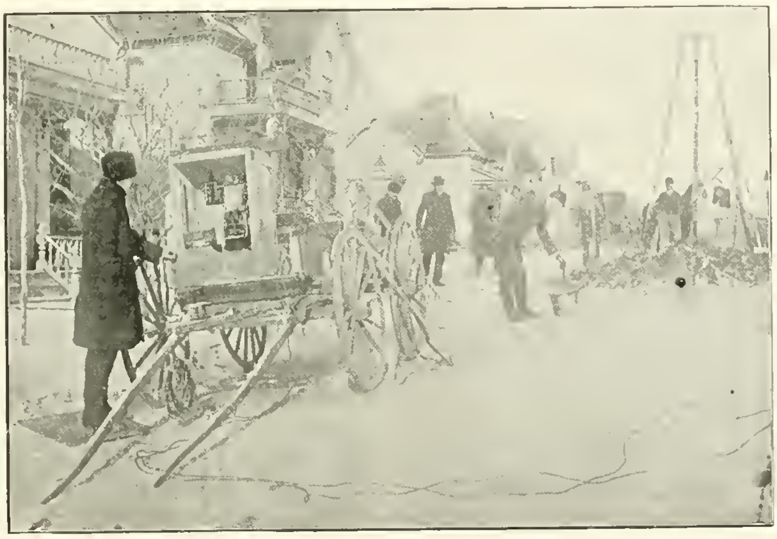
STEAM ENGINEERING JOURNAL.

VOL. IX. APRIL, 1899 No. 4.

THAWING OF WATER PIPES BY ELECTRICITY.

A NUMBER of successful experiments have recently been made in Canada and the United States with the use of electricity for thawing out frozen water pipes. The Canadian experiments were made in Ottawa, Berlin and Chatham. Below are printed particulars of the methods pursued in the above mentioned cities, together with illustrations showing the apparatus employed :

The Berlin Gas and Electric Co. used alternating current of 2,080 volts primary and 104 volts secondary ; this was further reduced by means of a water rheostat as described below to 50 volts. The apparatus, as shown in accompanying cut, consists of a large 200 light (40 G. S.K.C.) transformer, switchboard, several switches, C.G. watt meter to measure the current, all of which is placed on a small waggon for convenience in transportation, and a water rheostat. The water rheostat consists of the most simple type, a copper plate placed in the bottom of a wooden pail, another copper plate placed some 6″ to 8″ above the first and so arranged that it can be moved up and down as found necessary. There is enough water poured into the pail to well cover both plates. When in use the water is kept from boiling by the addition of snow or ice.



APPARATUS FOR THAWING OUT WATER PIPES.

The waggon is placed as near as possible to the place of operation. The wires of the primary circuit are brought to a D.P. switch on waggon switchboard, are then taken to the transformer, and back to a second D.P. switch on switchboard. The current is then conducted by two No. 6 wires to afford ample capacity for current without heating the wires and by means of a simple clamp these wires are attached to one end of frozen pipe. The second wire from the switch is then taken to the watt meter then by means of two No. 6 wires, is connected to lower plate in water rheostat. The wires from the top plate in the water rheostat are so connected to the other end of the frozen pipe that the frozen part remains between the terminals of the secondaries. A volt meter should be inserted in circuit after leaving the rheostat, and the rheostat so adjusted that the current will be reduced to 50 volts. In ordinary sizes of black or galvanized iron pipe the voltage should not exceed 50 volts. For from 4″ to 6″ cast iron pipes the pressure may be increased to 100 volts. In any case a strong ampere current should be used. The current in then turned on and carefully manipulated.

Only a very few moments are necessary ordinarily to thaw out water service pipes. The connections are made at any most convenient point where the pipe is exposed, a city hydrant, private pipe, or faucet in dwelling may be used.

It is necessary to use a source of current which does not affect the electric light lines by the grounding effected through connecting with the pipe, or danger may result.

In using this method to thaw the frozen condensation found in gas pipes the experience was that the thawing process had to be continued for a longer period of time.

Mr. John Murphy, superintendent of power houses, and Mr. W. G. Bradley, superintendent of construction for the Ottawa Electric Company, along with a representative of the City Engineer, conducted the experiments in Ottawa. Two Packard transformers, type F, made for 1,000 and 2,000 volts on the primaries, ratio of transformation of one to twenty, 125 cycles, were mounted on a sleigh and driven around where required. It was usually drawn up to the foot of the pole and primary wires carrying about 1,000 volts were brought down to the transformers by means of flexible wires. The transformers were worked in parallel and had the connections so made as to obtain a ratio of transformation of forty to one so that about 25 volts were obtained on the secondary. With this arrangement it was found possible to do without the reactive coil and other means of regulation which had been used in the first trials, so that the pipe-thawing outfit consisted simply of the two transformers above referred to and an ampere meter which was inserted on the primary, their being no portable instrument with large enough range to put on the secondary; a voltmeter was connected across the secondary coils.

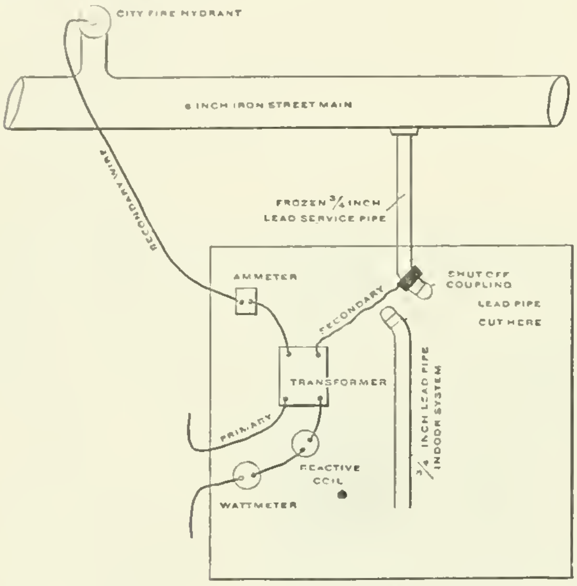
Following is the data of five trials which were made:

1st. Secondary volts 17, primary amperes 8. Connections made from water pipe 25 feet of ⅝" lead pipe to a hydrant at the door. Water flowed in three minutes and came out at full pressure in six minutes.

2nd. Secondary volts 21, primary amperes 5. Connections from water pipe in one house through about 100 feet ⅝" lead pipe and 16 feet 5" iron pipe to water tap in next house. One of the services only was frozen. Water flowed in eight minutes and with full pressure in ten minutes.

3rd. Secondary volts 22, primary amperes 9. Connections made to water tap inside and to iron main pipe in the street, which was reached by opening a man hole. Current passed through 25 feet ⅝" lead and 4 feet of 5" iron main. Water flowed freely in two minutes.

4th. Secondary volts 23, primary amperes 7. Connections made from water tap in one house through about 60 feet ⅝" lead and 24 feet of 5" iron pipe to the water taps in the next house. Water flowed in one minute and full pressure was on in 3 minutes.



Apparatus for Thawing out Water Pipes.

5th. A lead pipe service between a residence and a stable being frozen, connection was made between the water taps in each place and water flowed freely in one minute. No reading of current was taken in this last case.

By the time the pipes completely thawed out the water in some parts of them had become very hot. In some cases it was found impossible to get any current through at all. This was due to the style of joints made in some of the main iron pipes where there was no electrical contact between the different lengths.

The experiment at Chatham, which was also entirely successful, was conducted by Mr. Jones, Superintendent of Waterworks, by the aid of current and a transformer of 100 amperes capacity supplied by the Gas and Electric Co. Using a current of 52 volts, two frozen hydrants were thawed in 45 minutes.

From Germany comes another invention in the domain of electricity, says the Engineering Magazine, in the form of a remarkable current-interrupter, utilising a hitherto unappreciated fact in electrolysis, and this invention of Professor Wehnelt bids fair to effect a great increase in the capacity of induction coils, and in the generation of currents available for advanced researches in radiography.

CANADIAN ELECTRICAL ASSOCIATION.

A well attended meeting of the Executive Committee was held on March 23rd. A number of persons were elected to membership in the Association. The arrangements for the annual convention to be held in Hamilton in June were considered, and committees appointed to carry the same into effect. The exact date of the convention was left undecided, pending more definite information on the subject of transportation rates. The representatives of the various electrical companies of Hamilton are taking an active interest in the arrangements, and there is no cause to doubt that the convention this year wil be as interesting, instructive and enjoyable as any that have preceded it.

MARITIME ELECTRICAL ASSOCIATION CONVENTION.

The annual convention of the Maritime Electrical Association will be held in the city of Halifax, N.S., on Tuesday, April 18th, 1899. The outlook for the convention is quite promising, and the officers hope for a large attendance of members and persons interested in the electrical business. Following is a copy of the preliminary programme:

The convention headquarters will be at the new Victoria Hotel, corner of Morris and Hollis streets, and the meetings will be held in the Assembly room. The programme will be as follows:

9.30 a.m.—Meeting of the Executive Committee.

10 a. m.—President's address; report of secretary-treasurer; report of committees; election of officers; general business.

2 p.m.—Papers will be read by various members on: "Iron Armoured Conduit Wiring," "Fire Alarm Systems," "Steam Engineering," "Telephone Work" and "Electric Meters." Questions which have been suggested by the members will also be discussed.

In the evening a reception, consisting of banquet and smoking concert, will be tendered by the Halifax members of the Association. No effort is being spared to make this convention a success from every point of view; and all members attending will not only receive some very practical information from the papers to be read and the discussions which will follow, but will also find the occasion a most enjoyable one socially.

It is hoped that each individual member will not only endeavor to be present, but will also try to induce any eligible persons in his vicinity to send in applications for membership.

Members will purchase a single first-class ticket from their station to Halifax, getting at the same time a standard certificate, which, after being signed by the secretary, will entitle him to a return ticket free if ten or more have come by that line; if less than ten, a return ticket at half price.

Mr. W. H. Preece, C.B., F.R.S., has recently retired on a pension from the position of engineer-in-chief and electrician to the British General Post Office, he having reached the age limit of 65 years. He will, however, continue to act in a sort of consultative capacity to the post office, and in addition will carry on business on his own account in consulting electrical work in connection with lighting and traction. His connection with the telegraph and telephone extends over a period of 47 years. No announcement has yet been made as to who will be his successor.

QUESTIONS AND ANSWERS.

"S.T.D." writes : Will you kindly answer the following questions through the ELECTRICAL NEWS :

1st. What is the rule to find the amount of friction caused by the working parts of a machine, for example, say the piston, crank bearings, etc., of a steam engine of 100 h.p.

2nd. How do you find the striking force by gravitation—say a block of iron weighing 100 pounds dropped from a height of 100 feet.

3rd. Give rule to calculate the horse power developed by water, with a head 25 feet high and an outlet 3 feet square.

ANSWER.—1st. The easiest way of finding the amount of friction caused by the working parts of an engine is to take the brake horse power and subtract the same from the indicated horse power, and the difference is the amount spent on friction. In an engine the friction is distributed approximately as follows : Main bearings, 40% ; piston and rod, 27% ; crank pin, 7.% ; crosshead and wrist pin, 5.5% ; valve and rod, 14.% ; eccentric strap, 5.5%. The ordinary laws of friction for plain surfaces as given by Coulomb are :

(a) The friction between two bodies is directly proportional to the normal pressure between them.

(b) The friction is independent of the areas of the surfaces in contact.

(c) Kinetic friction is less than static friction, and is independent of velocity.

General Morin's experiments on axles showed practically the same general results as Coulombs for plain surfaces.

The following example will show how the horse power lost in friction is arrived at :

A shaft 3″ diameter has two bearings, one at each end, and between these bearings power is distributed from pulleys by belts. The tension in these belts has a horizontal pull of 1000 lbs and a vertical downward force of 550 lbs. at right angles to the shaft. The pulleys and shaft weigh 1750 lbs. The coefficient of friction (π) between shaft and bearings is .06. Find the horse power lost in friction if shaft makes 200 revolutions per minute?

We have here two forces acting on the shaft, (1) a horizontal force of 1,000 lbs., and (2) the vertical force of 250 lbs., together with the weight of pulleys and shaft, or altogether 2,000 lbs. These forces are at right angles, therefore the resultant pressure on the bearings is $R = \sqrt{1{,}000^2 + 2{,}000^2} = 2{,}244$ lbs.

This weight may or may not be equally distributed on the bearings, but for our present purpose we may consider same as being distributed on one.

The work lost in one revolution is = No. of feet travelled × coefficient of friction × resultant pressure = $\pi\, d\, u\, R$

when d = diameter of shaft in feet.
π = coefficient of friction = .06.
R = resultant pressure = 2244.
u = 3.1416.

The horse power lost in friction is = $\dfrac{\pi\, d\, n\, \pi\, R}{33{,}000}$

when n = No. of revolutions per minute.

$$3.1416 \times \frac{3}{12} \times \frac{200 \times .06 \times 2244}{33{,}000}$$

$$\frac{22 \times 3 \times 200 \times 6 \times 2244}{7 \times 12 \times 100 = 33{,}000} = .64 \text{ h.p.}$$

By referring to tables the coefficient of friction can be found or same can be arrived at by experiment.

2nd. The energy possessed by a moving body is obtained by finding the height through which it must fall to acquire the velocity of the motion. If this height is obtained the work done is equal to the height in feet × weight in pounds, or if

w = weight in lbs. and h = height in feet
the work done = w h foot pounds.

Therefore 100 lbs. × 100 feet = 10,000 ft. pounds would represent the amount of work stored up in the weight. This amount must be used up before the falling body can be brought to rest.

3rd. The power of a water fall is equal to the weight of water discharged in unit of time × total head.

If Q = cubic feet of water discharged per minute
W = weight of 1 cubic foot of water = 62.36 lbs.
H = total height in feet.

Then $\dfrac{Q\ W\ H}{33{,}000}$ = horse power.

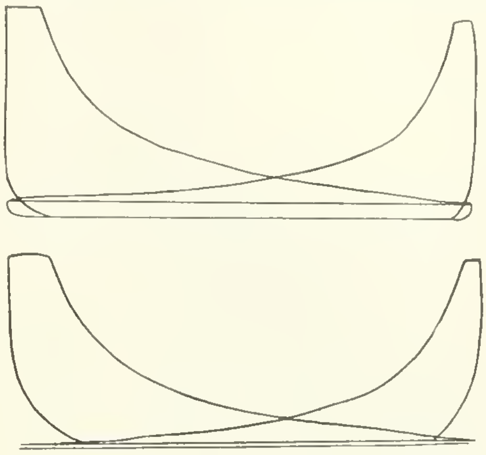
In the question the velocity of the stream is not given. This can be readily ascertained by measuring off say 100 feet on the bank, and throwing a piece of wood in the stream, and noting the time in passing the 100 feet marks. The average velocity is about 80° of the surface velocity.

The number of cubic feet that could flow through an outlet 3 feet square is about 2,200 per minute.

$$\therefore \frac{2{,}200 \times 62.36 \times 25}{33{,}000} = 104 \text{ h.p.}$$

From this amount would have to be deducted friction on turbine, etc., and the net available would be about 70 h.p.

"J.M.," Aylmer West, Ont., sends us indicator cards taken from a Wheelock engine, with the request that we work out the results for him. The original cards were 3½ inches in width, but as herewith shown are reduced by one-third.



ANSWER.—The diagrams, which we will call Nos. 1 and 2, were taken from a Wheelock engine, No. 1 with condenser on and No. 2 with condenser off ; engine, 14 × 34 ; revolutions, 90 ; steam pressure, as per gauge, 100 lbs.

Area of piston, 153.93″.
Speed of piston, 510′

Constant, $\dfrac{153.93 \times 510}{33{,}000} = 2.38$ h.p.

From card No. 1 the mean effective steam pressure is :

Crank end, 17.0.
Bright end, 21.6.
Average, $\dfrac{21.6 + 17.0}{2} = 19.3$ lbs.

Mean effective from the vacuum is 6.8 lbs.; total mean effective, $19.3 + 6.8 = 25.12$, and $25.12 \times 2.38 = 59.78$ h.p.

Diagram No. 2 scales as follows :

Crank end, M.E.P., 14.2.
Bright end, M.E.P., 18.6.

Total, $\dfrac{18.6 + 14.2}{2} = 16.4$ lbs., and $16.4 \times 2.38 = 39{,}032$ h.p.

The back pressure on this card is 2 lbs. This would represent $2.38 \times 2 = 4.76$ h.p., which is not taken into consideration in scaling for the above M.E.P., and should be added as load on the engine.

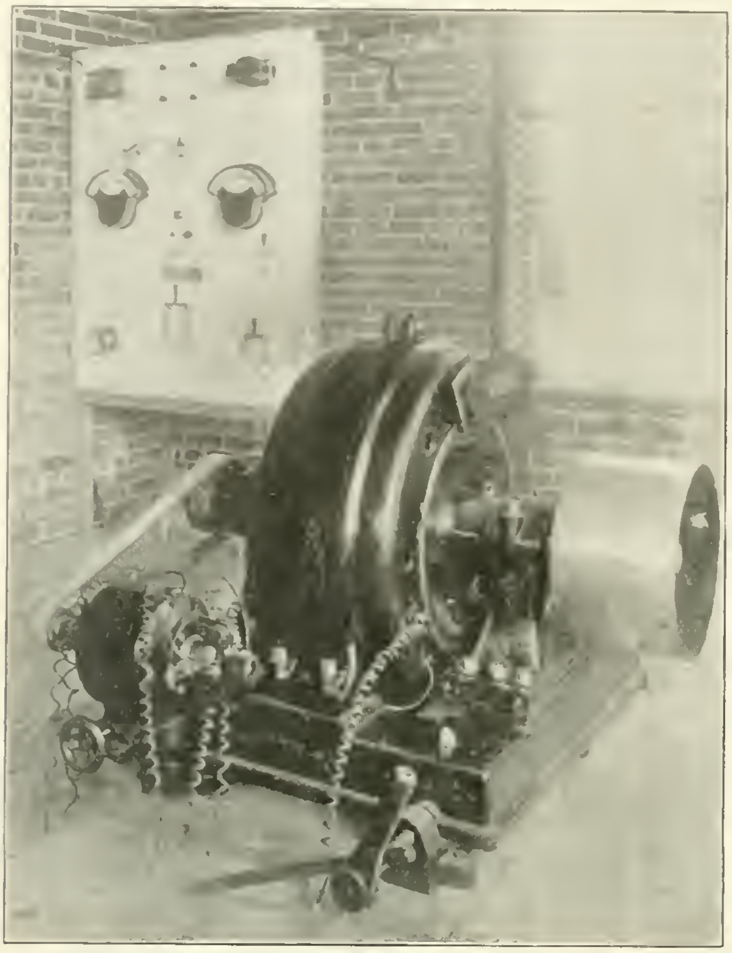
PREVENTION OF SCALE IN BOILERS.

In an article in the November issue of the Home Study Magazine, in answer to the question, 'Will carbonate of soda or plain soda remove hard sulphate of lime scale?' the expert replies, 'I have never found it to be much good for that purpose. I can tell you, however, what will remove it pretty effectually—very cheaply too—and that is ordinary kerosene. If this is fed to the boiler at the rate of about one quart per day per 100 h.p., the benefit to the boiler will soon be apparent. It has also been found to prevent, to quite an appreciable extent, the formation of hard scale. Its action upon the sulphate of lime does not seem to be a chemical one, however, but rather a mechanical action. In my opinion, the minute particles of sulphate of lime precipitated by the action of heat, are first carried to the surface of the water by the boiling and bubbling of the water. There they become coated over with the kerosene, which prevents them from uniting in solid mass when deposited on the plates.'

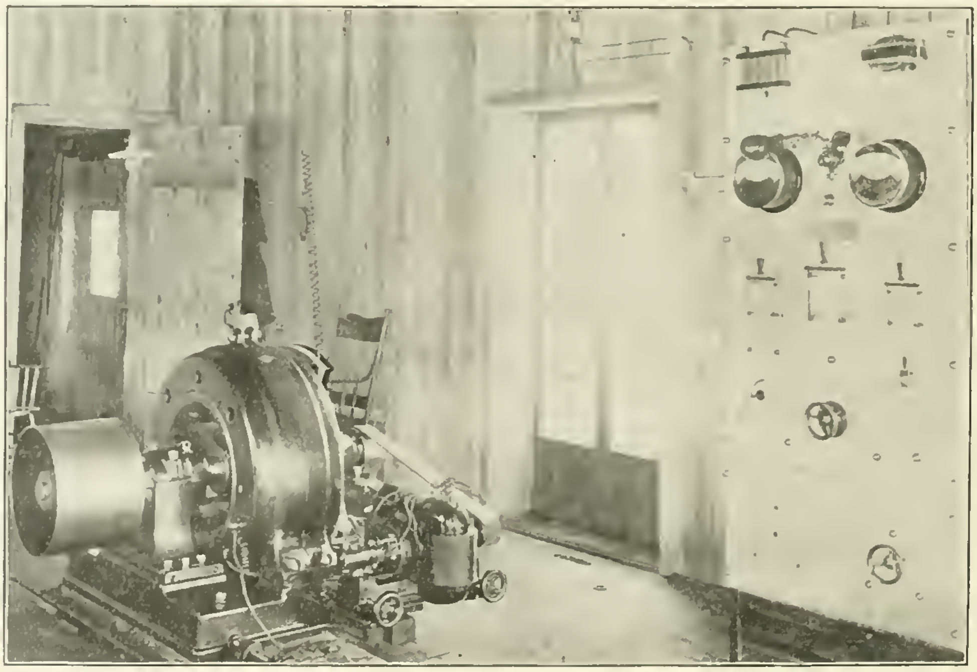
The Weston Electrical Instrument Company are making contracts for their new factory at Waverley, N.J., a suburb of Newark. A railway switch is now being constructed to the spot, and ground will be broken in a few days for the erection of what will probably be the most complete manufacturing establishment in the United States.

TWO MUNICIPAL LIGHTING PLANTS.

We print herewith illustrations of municipal lighting plants recently installed by the United Electric Company in the towns of Acton and Beeton. Some particulars of the former were printed in a previous number. The plant is installed in a stone building, 24 × 50 feet, and includes a 50 kilowatt alternating current generator with a capacity of 800 incandescent lights, a 2 panel marble switchboard fully equipped. Power is supplied by a 75 h.p. Wheelock engine manufactured by the Goldie & McCulloch Co., of Galt. The main driving belt is 16 inches in width and 65 feet long, and the dynamo a 10 inch, double, endless. There are fifty-six 32 candle power incandescent street lamps, arranged in two circuits independent of each other, and a third independent circuit for domestic and commercial service. The Beeton plant is very similar to the one at Acton. Besides furnishing light for the streets and commercial and domestic use current is supplied for 200 incandescent lights at the County House of Industry.



Municipal Plant, Beeton, Ont.



Municipal Plant, Acton, Ont.

In a letter to the Company the reeve of the municipality expresses his appreciation and that of the citizens with the satisfactory working of the plant, and refers particularly to the good regulation and freedom from heating. Over 600 16 c.p. lights have already been installed.

GLASGOW AND ELECTRICAL PROGRESS.

Although Glasgow may consider itself in many respects the centre of light and leading, it has by no means made astonishing progress in municipal electrical work. The population of Glasgow is 657,000, and the rateable value £4,046,726; Manchester, on the other hand, has a population of 530,000, and a rateable value £2,911,083. Curiously enough, the municipal control of electric lighting commenced in these cities within a few months of each other, but the latest returns show a marked difference in the two systems, as will be seen from the following figures :

	35 watt lamps.	Units sold.	Revenue.
Manchester.......	123,595	1,748,244	£38,253
Glasgow..........	79,140	1,090,959	£25,862

For years past the Glasgow Corporation has owned probably the most paying system of tramways in the kingdom, and four or five years ago a committee collected an amazing mass of information on the subject of working tramways by electrical means; moreover, it was generally accepted that electrical working was far and away the best system. Four years ago the tramways in Leeds were owned and worked by a company, yet to-day the Corporation of Leeds has not only taken over the whole of the city tramways, but has equipped 10 miles with the overhead trolley system—and Glasgow to-day is in a difficulty about running a short experimental line on the same system. Notwithstanding, Glasgow has sufficient confidence in itself to be desirous of of acquiring and working a telephone system.—Electrical Review, London, Eng.

CAPT. JAMES WRIGHT.

It is with much regret that we chronicle the death of Capt. James Wright, mechanical engineer, of Montreal. By his wide circle af acquaintances throughout Canada he was held in highest esteem, not only in recognition of his great ability in his profession, but also of his many sterling personal qualities. To such the accompanying portrait and biographical particulars will be of interest :

Capt. James Wright was born in Tarbolton, Ayrshire, Scotland, Sept. 23, 1826, and when about 12 years old emigrated to New York, where he received a common school education and at about 16 years came to Allenburg, Ont., where he served his time and learned the trade of blacksmith with an uncle. He then went to work with Jas. Oswald, a contractor, and got his first experience with dredging machinery in the harbors of Boston and New York, and later on in the Erie and Welland canals. He then came to Montreal with the first spoon dredge used in the Montreal harbor, and finally became mechanical superintendent of the Montreal harbor, which position he occupied for twelve years. In 1876, together with F. B. McNamee and A. G. Nish he formed the firm of F. B. McNamee & Co., which firm constructed that portion of the Montreal water works acqueduct, known as the Inland Cut, the Carillion dam across the Ottawa river, and took part in the deepening of Lachine and Welland canals, and the Toronto water works extension. Leaving the firm he then took up the business of a mechanical expert, and as an authority on the steam indicator was well known.

Capt. James Wright.

In 1885 together with A. G. Nish and M. F. Lefebre, he formed the Mount Royal Park Incline Co., which firm built the present incline railway up the side of Mount Royal, from plans drawn up by him and directly under his supervision.

Capt. Wright was noted for his wonderful memory, and it is said was never known to forget anything he had read twice.

He leaves a wife and one son, an electrical engineer in Mexico.

Judgment has been reserved in the action brought to ascertain whether the mortgage held by the Sun Life Insurance Co., against the Cornwall Electric Street Railway Co., covers the rolling stock, extensions, etc.

EDUCATING OPERATORS IN THE HANDLING OF THE SWITCHBOARD.*

Writing a paper to be read before the members of the association is a difficult task for me, knowing full well that anything I might write, on any subject, would in no way compare with any paper prepared by any other member of the association. But if in writing a paper I chance to say anything that will be of any benefit to the association in general, or a single member of the same, I will feel that I have been amply paid for the effort.

In the beginning I will say that the chief trouble to the telegraph service on railroads is the inefficiency of operators. An operator may be able to handle train orders and other business in a highly satisfactory manner ; he may be a good sender and attentive, and still not be able to make the simplest kind of a patch in case of wire trouble when called upon to do it by the dispatcher. This one failure on his part very materially reduces his value as an operator, and the dispatcher, in nine cases out of ten, reports him as being unfit for his position, which is true to a certain extent.

Mr. A. R. Lingfelt produced a paper that was read before the members of the Association at the meeting of 1-94, which was able, concise, and deserved far more than a passing thought. Too much can not be said or written on this subject. Any one giving the matter careful thought can not help but see that the question of educating operators in the workings of the switchboard is one that demands serious consideration.

In hiring and placing operators, I feel sure that superintendents of telegraph and chief dispatchers do not always handle the matter as it should be handled. In far too many instances they hire and place an operator wholly on the grounds that "he is a fair operator, can handle train orders well, make a fair copy, and has a good record as to character." These qualifications are certainly essential, but his qualifictions ought not to end there. We will say that he is hired and sent to "J" to work nights. The dispatcher has outstanding orders to trains all over the division ; a storm comes, playing havoc with the wires, putting the train wire in a useless condition ; the dispatcher locates the trouble, and soon sees that he can get a through train wire by having the operator at "J" put No. 7 north to No. 10 south. He instructs him to make the patch, and finds out, to his disgust, that the operator cannot do it, and trains might remain tied up until doomsday, just because an operator does not know how to make a simple patch. As a general thing, when a dispatcher wants a wire, he wants it like the "man in Texas wanted the revolver ;" that is, bad ; and if he don't get it promptly—and his disposition is not the best in the world—he is apt to abuse the operator for being unable to render the proper assistance. This is wrong. The operator is not to blame. The official placing him in the office is far more responsible than the operator is, because the chances are that no one ever showed the operator how to manipulate a switchboard. Under the circumstances, he could not be expected to do it. Had he been shown by the superintendent of telegraph or chief dispatcher how to do such work before he took charge of the office, and been told plainly that he must be able to do such work when called upon, or would not be retained in the service, the chances are that he would have made a study of the board from the time he went into the office, and would have been able to have made the patch when it was required of him.

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* Read before the Association of Railway Telegraph Superintendents, Fortress Munroe, Va., by W. F. Packard, of Lima, Ohio.

One of the greatest troubles is wire failure, and if patching can not be done promply, trains have to suffer. If operaters do not know how to do it, it can not be done.

I do not wish to write or speak disparagingly of operators, or officials placing them, but I will venture to say that any division on any road in the country can be selected that has 20 offices, and there will not be more than two operators on it that can make a simple patch of one wire north to another south, east or west, unless they have had previous practical instructions. I do not think I have overdrawn this. I base my statement on the observations I have made during the years of experience I have had as a train dispatcher and in other capacities. I have never worked on a road that my experience has not been about the same in that respect. In my opinion, it lies with the superintendents of telegraph and chief dispatchers to obviate a great deal of this trouble.

No operator should be placed in charge of an office unless he is posted in working a board of an ordinary kind by the official placing him. He should be shown how to do patching, the position of the plugs when wires are in their normal condition or position ; in fact, the back straps should be gone over, explaining their relation to the plug strips, etc., etc. This would take but little time, and would be starting the operator in right.

There is another thing that could be done that would certainly prove to be a great benefit ; that is, to provide every office with a blue print or hektograph drawing of the standard switchboard, showing it in its natural condition. Plug holes should be numbered on the print. This, together with a "key" at the bottom or top of the print, showing where to place plugs for certain patches, would render the work simple, so much so that any one who could read could do it.

Any operator of limited experience, after working in an office a short while equipped as I have shown ; would be able to handle the board in any office whereever he might be placed, as there is no radical difference in boards now in use on nearly all the roads in the country. I feel sure that such a course as I suggest, if adopted on railroads, would not only benefit the telegraph service to a great extent, but raise the operators to a higher plane of usefulness.

Any superintendent of telegraph or chief dispatcher should be able to make a crude drawing of the print I refer to, to enable the engineering department to make the print. They could be made in the above department at a small cost, and in such a shape that they would meet all that would be required of them for the equipment of offices.

This communication is not intended as a criticism on any one hiring or placing operators, or on the operaors themselves, but is written with a view of offering suggestions that I hope may turn some thought in the direction referred to, and that some practical improvement may be made.

The Dominion Oilcloth Co., of Montreal have placed an order with the Royal Electric Co. for the complete equipment of their factory with S. K. C. motors, aggregate over 150 h. p., the different units as required throughout the building in the different departments.

ELECTRICAL INSPECTION IN WINNIPEG, MAN.

A representative of the Electrical News lately interviewed Mr. F. A. Cambridge, the newly appointed city electrician of Winnipeg, Man, in reference to electrical inspection. He learned that all new wiring and electrical installations have to be done in strict conformity with the National Code, 1897 edition, which is incorporated in the city regulations. No electrical work can be undertaken without a permit, and certificate must be obtained before work is finally passed. No fees are charged either for inspection or permits. Some difficulty has been experienced owing to the fact that the improved list of the National Code does not include many articles of Canadian manufacture. Mr. Cambridge hopes that before long other cities in this country will follow the example of Winnipeg, and that there may be formed some kind of a testing bureau, preferably by the associated Underwriters' associations, presided over by some reliable expert, who may be referred to in matters of dispute, or from whom impartial opinions may be obtained regarding materials or practice. In this connection Mr. Cambridge acknowledges the great kindness of Mr. Merrill, jr., the chief electrician of the National Board of Underwriters for America. That body maintains a complete bureau at Chicago. Winnipeg is acting in connection with the bureau, and gives and receives full accounts of all elecrrical burnouts, etc.

Regarding old installations it is understood to be the intention of the city electrician of Winnipeg to make a thorough inspection of all these. Some progress has been made already and the general public as a rule are pleased to carry out the alterations ordered. Mr. Cambridge believes that this work should be taken up at once by every city, for the longer it is left undone the greater expense the public will ultimately have to bear.

ELECTRICAL EXHIBITION.

The twenty-second convention of the National Electric Light Association and third Electrical Exhibition is announced to be held in Madison Square Garden, New York, during the month of May. The scope of the exhibition will not be confined merely to electrical apparatus and appliances, but will include all kindred industries as well, such as various makes of boilers, pumps, steam engines and other steam specialities. A special feature of the coming exhibition will be the display of patents and new devices. Last year the Electrical and Kindred Industries Exhibition was held under the auspices of the New York Electrical Society, but this year it is proposed to hold it in conjunction with the convention of the National Electrical Light Association. As a result, considerable interest has been awakened in the coming exhibition.

The subject of the construction of an electric railroad from Guelph to Hespeler, Arthur and Erin, is engaging the attention of the Board of Trade and citizens of Guelph. It is stated that if $25,000 to $30,000 of local capital can be raised, capitalists can be found who will contribute the additional amount required.

The British Columbia Electric Railway Co. will no doubt pay a good dividend in the near future. The net earnings of the company from April 1st last to the end of the year amounted to $126,487, as against $67,582, for the like period of 1897. The company are now erecting a large car barn at Vancouver. Mr. J. M. Buntzen, manager of the company, has gone to England, where he will lay before the directors plans for several extensions of the system.

TRIAL BY JURY.

TRUTH is stranger than fiction. Gilbert and Sullivan, in the wildest flights of their imagination could not have portrayed a more farcical denouement than that of a verdict brought in by a jury of twelve of our fellow countrymen at the assizes at Toronto. The case was that of Harris v. Toronto Electric Light Co. for $10,000 damages. Harris was a purveyor of rags and bottles, and kept these rags and bottles in a rough-cast building. In this building he had in use a motor, supplied with current from the wires of the defendant company. These wires were tapped on Harris' premises by a small pair of wires, which were attached to a corner of the rough-cast building aforesaid, and from thence taken over to a doctor's residence on the next street. Herein lay the offence the wires leading to another man's premises were run on sideblocks on the outside of the rough-cast rag emporium, as the plaintiff said, without his consent. He saw the wires being so attached and enquired of the linemen what they were for, and was told. He made no objection. The wires remained there two years or more, and never a word was said. On the 18th of September last—a Sunday afternoon—the rags, as rags often will, ignited spontaneously or got on fire in some way, and the rag shop was laid in ruins. As the flimsy walls collapsed, the wires attached to the outside were tangled up and, of course, short-circuited, and burnt the insulation. Harris promptly brought suit for ten thousand dollars against the company defendant. The case was tried in Toronto last week.

The nature of the evidence put in may be gathered from the testimony of one of the witnesses. This was a lady who was oppressed with a foreboding that Harris's was to be destroyed by electricity. She said that she had frequently seen the electricity running up the wires on William street from Queen street and turning the corner and going into Harris's, and on this identical Sunday she had seen some of it go up the street and cross over into the rag bureau about two hours before the fire. Several other witnesses also testified that they saw the wires flashing fire, and then the raggery burst into a blaze of glory. There was a remarkable unanimity in their testimony—first, fire on the wires, then immediately the flames bursting out from the inside and through the roof. This was about the time of the arrival of the fire apparatus. These witnesses all were on the south side of the building.

Now for the defence. The evidence of several reputable witnesses living on Simcoe street, to the east of the building, went to show that they were the first to see the fire; that it started in the centre of the building entirely away from where the wires were attached; that they telephoned the alarm to the police station at 2.35, and that at this time there was no fire outside the building at all. Evidence was produced by a number of witnesses that the short circuit caused by collapse of building occurred at the power house at 2.47, or 12 minutes after the alarm was given, and probably 20 or 25 minutes after the fire broke out. The evidence of these witnesses was clear as to the facts.

As to the values.—It appears that Harris had appealed on his assessment and took an oath before the Court of Revision three days before the fire that there was not five hundred dollars' worth of goods in the place, and that a big pile of the stuff represented very little money. Two members of the Court of Revision were put upon the stand and testified to this. He now swore there was eight thousand dollars' worth. The defendants could not contradict, as the evidence was destroyed—Harris kept no books.

His Lordship was impressed throughout the case with the evidence submitted by the plaintiff's witnesses, on the ground that their statements were based on what they had seen with their own eyes. On the other hand, little or no importance was attached apparently by the jury to the evidence of the other gentlemen who said that they saw the fire start in another place and gave the alarm. The onus was upon the defendants to prove that the contents of the building were not worth $10,000; this they had failed to do. As to the plaintiff's sworn statement before the Court of Revision regarding the value of his goods, it was not allowed to affect his veracity in the present case. His Lordship left to the jury the difficulty of accounting for the difference in time between the fire alarm and the starting of the fire and the time of the short circuit at the company's works.

The jury went out and deliberated for a couple of hours, and then came into Court and asked the Judge if they could not make the damage $14,000 instead of $10,000! The Judge appeared staggered at this, and he instructed them that they could not award more than was claimed, so they made it the ten thousand.

The only serious feature of this case appears to be the position in which the defendant company is placed by the jury's award, and the effect of the decision upon electrical companies throughout the country. There is no doubt that every company doing business has a number of these double services in operation. Electric light companies will be kept in hot water unless they find means to protect themselves. This can be done by special agreement before entering upon any person's premises for purposes of business—an iron-clad agreement of protection and indemification from risks of damage of every kind—alleged and actual—from fire, flood and the fortunes of war.

MOONLIGHT SCHEDULE FOR APRIL.

Day of Month	Light.		Extinguish.		No. of Hours.
		H.M.		H.M.	H.M.
1....	P.M.	6.50	A.M.	1.00	6.10
2....	"	6.50	"	1.30	6.40
3....	"	6.50	"	2.20	7.30
4....	"	6.50	"	3.00	8.10
5....	"	6.50	"	3.40	8.50
6....	"	6.50	"	4.20	9.30
7....	"	7.00	"	4.40	9.40
8....	"	7.00	"	4.40	9.40
9....	"	7.00	"	4.40	9.40
10....	"	7.00	"	4.40	9.40
11....	"	7.00	"	4.30	9.30
12....	"	8.00	"	4.30	8.30
13....	"	9.40	"	4.30	6.50
14....	"	10.20	"	4.20	6.00
15....	"	11.00	"	4.20	5.20
16....	"	11.10	"	4.20	5.10
17....	"	11.50	"	4.20	4.30
18....	....		"	4.20	3.50
19....	A.M.	12.30		.....	
20....	"	1.20	"	4.20	3.00
21....	"	1.50	"	4.20	2.30
22....	No Light.		No Light.		.....
23....	No Light.		No Light.		.....
24....	No Light.		No Light.		.....
25....	No Light.		No Light.		.....
26....	P.M.	7.00	P.M.	9.20	2.20
27....	"	7.20	"	10.20	3.00
28....	"	7.20	"	11.20	4.00
29....	"	7.20	A.M.	12.20	5.00
30....	"	7.20	"	1.00	5.40
			Total.........		160.40

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Correspondence is invited upon all topics legitimately coming within the scope of this journal.

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Water Power Problems.

The severity of the weather during the past winter proved a serious obstacle to the operation of water powers, more particularly at Lachine and Niagara, where Jack Frost seemed determined to seal up the water supply and compel the closing down of the electric power stations. The water in the canals leading to the stations on both sides of the Niagara river was diverted by masses of ice which became attached to projecting rocks above the falls. On several occasions the Niagara Falls Park and River Railway was obliged to cease operations on account of lack of water due to the above cause and to the blocking of the water inlet. Reference has been made in previous issues to the unusual difficulties under which the plant of Lachine Rapids Hydraulic and Land Company was operated owing to the large accumulation of frazil or anchor ice. These troubles emphasize the fact, says the Electrical Engineer, that hydraulic engineering can no longer be excluded from the scope of a complete electrical engineering education, any more than civil and mechanical engineering.

The Consolidation Idea.

The rapidity with which enormous business combinations are being formed in the United States is the most wonderful feature in the record of recent events. The trend of business and capital in this direction is being watched with the greatest interest and not without anxiety as to the outcome. Naturally the influence of these combinations is felt in Canada, and there is a disposition to follow on a smaller scale the example so daringly set us by our neighbors. Combinations have already been effected between several of the most important financial corporations of Toronto, with a prospect of more to follow. It is reported that the Canadian manufacturers of bicycles will be forced to form a trust among themselves or become a part of the combine recently formed in the United States. The electrical interests are also likely to be affected. Indeed, a report is current that negotiations are now in progress for the consolidation under one management—probably that of the Cataract Construction Co.—of the various electric lighting and street railway companies whose headquarters are in Hamilton. We certainly think that benefit would accrue to the industry from the amalgamation of a number of the rival lighting companies which are now engaged in the unprofitable and thankless task of cutting one another's throats in some of the smaller towns.

The Conmee Bill

In this issue will be found Mr. Conmee's Bill as adopted by the Ontario Legislature, defining a method for the adjustment of disputes between municipal corporations and private electric lighting companies as well as the terms upon which municipalities shall in future be permitted to engage in the business of public lighting. The measure has been carefully framed, and when put in operation will no doubt prove advantageous to both the municipalities and the companies. It puts an end to a condition of affairs under which electric lighting companies were in constant danger of having their property wiped out of existence by the municipality, and therefore were not in a position to make further investments for necessary improvements. On the other hand the municipality is now able to secure public lighting from the companies on their own terms or at a price which competent arbitrators shall decide to be reasonable and fair. During the time that the Bill was before the Legislature it was subjected to much unfair criticism and opposition from some of the public newspapers, which, in their anxiety to appear as public champions, did not take the trouble to learn what its provisions were. Since its adoption they have declared that the electric lighting companies will now proceed to tyrannize over the municipalities. A perusal of the Bill will show that even should the companies desire to act the part of tyrants, which they certainly do not, the restrictions put upon them by the new legislation are a sufficient safeguard to the public interests. In consequence of the relations between lighting companies and municipalities having been thus defined, there is likely to be a return of confidence leading to the investment of capital in the improvement and extension of electric lighting properties.

Price of Elecric Power.

THE councillors of the town of Orillia, Ont., apparently have but a vague conception of the cost of producing electricity. As our readers know, they are about to embark upon an undertaking to supply light and power to the town from Ragged Rapids, nineteen miles distant, this being the first instance in Canada, if not in the world, of a municipality installing a long distance electrical power transmission plant. There are two essential features necessary to the successful operation of any plant, whether controlled by public or private interests. The first is, that the design and construction of the plant shall be as nearly perfect as possible, and adapted to the conditions under which it must operate ; the second is of equal importance, that the power shall be disposed of at a price which bears due relation to the cost of production. As to the design and construction of the Orillia plant it is yet too early to speak definitely, but in this respect we anticipate no obstacle to success. Our skepticism is aroused, however, by the price which has been placed upon the power to be produced, and we are led to the conclusion that upon this point the councillors must have shouldered the responsibility themselves, instead of obtaining proper advice. It is reported that power is being offered, delivered in Orillia at about fourteen dollars per horse power per annum, while the town of Gravenhurst which recently applied for power, was quoted a price of ten dollars per horse power per annum for one or two hundred horse power, at the power house at Ragged Rapids, the town to build and maintain its transmission line and transformer station. We believe that these prices will be found to be below the actual cost of operation, and that if the plant is to be a financial success, the rates for current must necessarily be increased in a substantial degree.

Copper and Aluminium.

There is no occasion to doubt the tenacity of the grip which the copper trust of the United States have secured. Prices have been forced upward to an extent which has very seriously affected the electrical industry in particular, as well as many other departments of trade. We are advised that many electrical enterprises which had been planned for this season, are hanging fire because of the unexpected and serious increase in cost of construction due to the heavy advance in copper. Building enterprise in cities where electric wiring is employed is being hampered from the same cause. Under these circumstances the electrical fraternity will watch with interest the experiment which is to be made at Orillia with aluminium as a conductor. Reference was made in our last issue to the fact that with the consent of the municipality of the town of Orillia a contract had been given to a Pittsburg firm for aluminium wire conductors for the electric transmission system at that place. The manufacturers of aluminium wire are to be congratulated upon the opportunity thus afforded them to demonstrate its utility and advantages for electrical purposes. It may occasion surprise that the Council of Orillia should have consented to allow the new material to be used for so important a transmission line. It is understood however that the town's consulting engineer, Mr. R. J. Parke, has carefully investigated the matter and is satisfied that aluminium wire will meet the requirements, and at a substantial reduction in cost. Furthermore the contractors have given the municipality their written guarantee concerning the tensile strength, conductivity, durability and less liability than copper to physical disintegration under the natural conditions which may affect the transmission line while in operation on the poles, and have undertaken to replace and put in satisfactory working condition any wires which may prove defective. The conductivity of pure aluminum wire is given as 63% and about 54% when containing 2% of alloy. The tensile strength of pure aluminium in sizes such as will be required for the Orillia line is about 24,000 lbs. It is proposed however, to employ a wire with a conductivity of 59% and a tensile strength of 29,000 lbs. per square inch. Assuming that aluminium has a conductivity of 59% and copper a conductivity of 97% the comparative cross-section of aluminium wire of equal conductivity to copper will be as 163 to 100. The diameter of No. 4 B. & S. copper wire, which would be the size required for this line, is .204, or an area of 41742 circular mills. It is estimated that aluminium wire of equal conductivity should have an area of 68,000 circular mills and a diameter of .260. The weight of aluminium as compared with copper is 3.33. The weight of aluminium of equal conductivity with copper, is 49 per cent. of the weight of copper. As to comparative price, assuming a fair price for copper to be 20 cents per lb., 41 cents per lb. for aluminium would give the same cost per mile of line work, inasmuch as the weight of the aluminium would be only 49 per cent. of the weight of the copper. It is understood that the manufacturers of aluminium are watching very closely the copper market and are advancing or lowering the price of their material in such a way as to be able to offer an inducement to purchasers, while not letting go more profit than is absolutely necessary. Owing to its greater cross-section, due to lesser conductivity, the cost of insulating aluminium wire is almost double that of copper wire. Thus there is little or no advantage in price, except where bare wires can be used. This fact will greatly restrict the use of the new material. The only transmission line thus far constructed with aluminum wire is that of the Snoqualmie Falls Power Co., Seattle, W. T. This line, including branches, is 74 miles in length, and was completed in the autumn of last year, but has not yet been put in operation, so that no practical working results are obtainable.

BY THE WAY.

Mr. Carter, an old time Canadian operator tells an interesting story of his work with Edison 25 years ago. The two were working at Stratford, where Edison was station telegraph operator. There was a mistake in some order, and a collision was narrowly averted, Edison in consequence, had to face the superintendent at the old Union Station, Toronto, who rated him roundly for his "criminal carelessness." It was more than the young genius could stand, and, quietly exclaiming that he had had enough, Edison slipped on his coat and then severed his connection with the company. A short time ago Mr. Carter visited Edison at Jersey City, and the two laughed over the Stratford episode.

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This is the way municipal control of the electric light and telephone has worked out at Crawfordsville, Ind., as recorded in the Indianapolis News of March 15th: "More rottenness is being unearthed by the investigating committee of the city council. Last week it developed that a number of city employees were supplied with telephones for which the city paid, and last night it came out that a number of others are supplied with free service by the management of the city electric light plant. All those connected with the plant are said to be using the light without price, whereas the management began to refuse pay applicants on the service some time ago, on the ground that the plant was already loaded to its carrying capacity. It now develops that every employee of the plant has his house wired and is using all lights desired. The exposure has caused a breeze of indignation, and the superintendent has been ordered to cut off all deadhead service at once."

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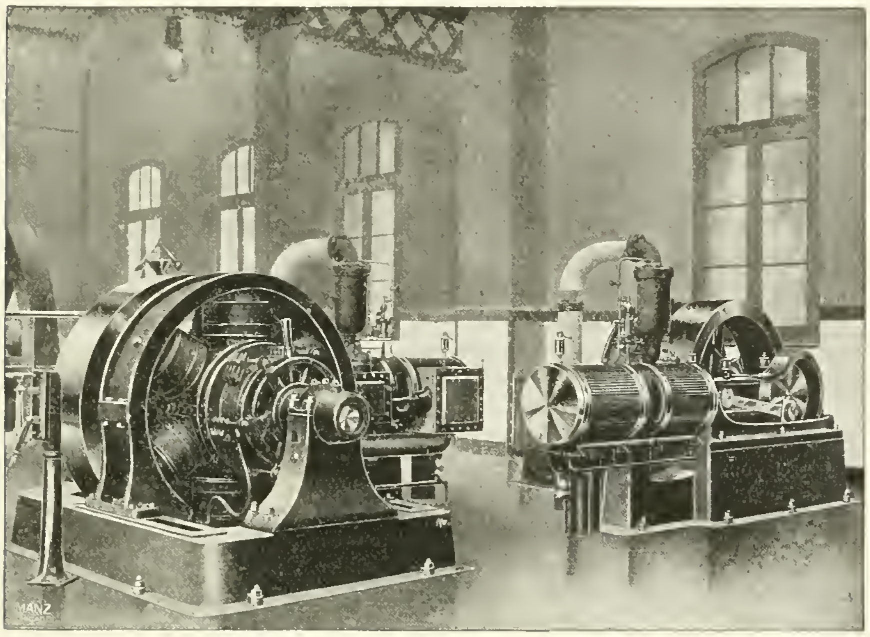
In the early '80's, when electricity was indeed in its infancy, Mr. J. J. Wright, the present manager of the Toronto Electric Light Co., started into the business on a very modest scale in Toronto. He rented a small machine shop off Yonge street, and there made his own apparatus. No attempt was made to light the streets, but a number of the stores were served with arc lights. In the day time the promoter of the new enterprise was busily engaged in stringing wires, trimming lamps and soliciting customers, and at night he took charge of the operation of the plant and the construction of dynamos and other apparatus. He even tried his hand at making carbons in the hope of reducing their cost, the price then being nine or ten cents apiece. In the following extract from a letter written to a friend Mr. Wright describes in characteristic language the modus operandi of carbon making as practiced by himself: "The first carbons I ever made or used were round in the shape of a wheel and I rammed the stuff in a cast iron mould and then made the mould red hot something after the manner of the Chinaman who when he wanted roast pork burnt down his house to cook the pig. You make me smile when you ask me the resistance of the first carbon I used. In those days I was 'unacquainted with the nature of an ohm' so to speak, and considered myself pretty lucky if I could get a current to go through my carbons on any terms. I wasn't fastidious. I didn't require to know system, candle power and strength of current in use' and whether coppered or plain—not much. I was perfectly satisfied when I could make a carbon that wasn't an insulator, and did not worry myself into a decline because two of them did not last an equal time on the same current to a fraction of a second. The first carbons I remember as practical carbons were Brush. They were square, but I have no data respecting them. Since then, I have used every kind, round, square, soft, hard, some with a hole through the center and some with a core, but I never knew what fun was till I started in to make carbons in Canada. I didn't have the first idea what they were made of and had to work it all out for myself. Carbons were costing me from 9 to 10 cents each in those days and it was an inducement. If I was to tell you the different kinds of stuff I put in carbons, you would die standing up. You would not have time to fall down. I got very fair results from gas carbon and molasses, but dropped the molasses and took to tar. The carbons were all right but would blaze somewhat. At last I got to making fair to middling carbons, but they were of the now-you-see-'em-and-now-you-don't kind. One lot would go all right, and then the next night my lamps would not start up, and after forcing the current round for a time, I would go round and find all the fine wire shunts burnt to a cinder. Another time they would get red hot all the way up to the holders and they would burn to a beautiful point. After a while I got to making them all right, and had pretty fair success, but the reduction in price knocked me out. I could buy cheaper than make, but if it were profitable to rake up such matters, I could a tale unfold in regard to what I know about carbons 'that would make your knotted and combined locks to part and each particular hair to stand on end like quills upon the fretful porcupine,' but of what avail? it would be of no use, so I have only to repeat what I said at the start, that for accurate data I am not there, but for experience, largely comic but quite often the reverse, I believe I could fill a book."

Charles J. Pippin, night watchman, at the parliament buildings Toronto, has been appointed engineer at the Deaf and Dumb Institute, Bellville.

CANADIAN ENGINES IN SPAIN.

In October, 1897, contracts were placed for the equipment of electric tramways in Barcelona and Madrid, the two most important cities in Spain. The work was completed a few months ago, and the lines are now in successful operation. Barcelona, with a population of about 600,000, is the largest city in Spain, and is an important seaport and manufacturing centre. It is an ideal city in many respects, but particularly from the standpoint of the owners of the electric railway, as it is well patronized on account of the climate being too warm for much walking. Madrid is the capital of Spain, and is nearly as large as Barcelona. It is situated inland, and has many parks, broad streets and fine buildings. In the character of its population it resembles a western American city, as not more than 40 per cent. of its residents are natives.



Robb-Armstrong Engines at Barcelona.

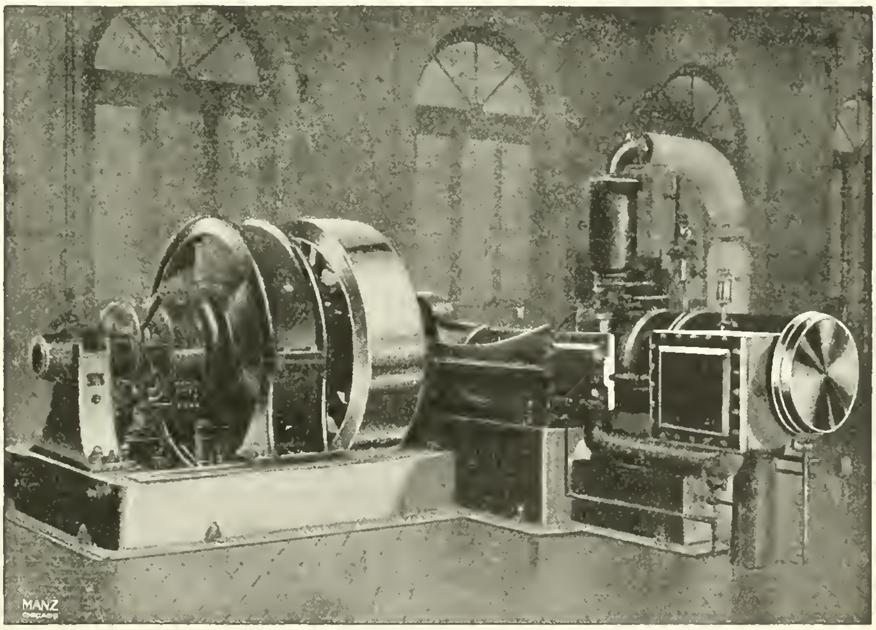
Although these systems are owned by British capital, and were built by British contractors, much of the apparatus was purchased on this side of the Atlantic. The main engines were manufactured in the United States, and three smaller engines were supplied by the Robb Engineering Company, of Amherst, N.S. These latter engines, as shown in the accompanying illustrations, are tandem compound, side crank type, with dynamos direct connected. They were installed principally for lighting the extensive car sheds and driving the machinery in the workshops connected with the tramway system, but are also used for running part of the cars late at night or early in the morning when the main engines are shut down.

The high pressure cylinder of these engines is 10 inches in diameter, low pressure 16 inches in diameter, stroke 15 inches, and they are rated at 115 horse power each. Both valves are controlled by the automatic governor in such a way as to divide the work equally between the two cylinders. The crank shaft, connecting rod and crank pin are of hammered open-hearth steel. The high pressure cylinder is placed next the frame, and the low pressure in the rear, so that the cylinder heads and pistons can be removed without disturbing the cylinders. The throttle consists of a flat valve rotated through one-half revolution by a lever, and as the valve and seat are protected from the steam whether open or shut, they can neither wear nor rust. The main bearings have a ring oiling device, the oil being continuously conveyed from a cavity beneath the bearing to the top of the shaft by metal rings which dip in the oil. All bearings are large and the parts of the engines few and simple and as strong as possible, making them well adapted to any service where continuous running and variable or severe work is required.

It is highly creditable to the Robb Engineering Company that their engines were selected as part of these installations, which are said to be the most important undertakings of the kind completed in any part of the world during the year 1898. The products of the Robb Company have been favorably known throughout Canada for a number of years, and we have no doubt their foreign shipments, which have been quite numerous during the past year will give as good satisfaction and lead to a large increase of their business.

ACETYLENE GAS EXPLOSION.

On January 5th the village of Merrickville, Ont., was startled by a terrific explosion, which, on investigation, proved to have occurred on the premises occupied by the A. B. Scott Co., general merchants, due to the explosion of their acetylene gas machine. The plate glass windows in the front of the building were almost totally wrecked; the windows on the second floor were also broken out. A large window in the centre of the back of the building was completely destroyed, being blown out, with its frame, leaving nothing but the brickwork. The cellar doors leading to the machine were broken from their hinges. Fortunately, no one was seriously injured.



Robb-Armstbong Engines at Madrid.

THE CONMEE BILL.

Following are the provisions of the Conmee Bill as adopted by the Ontario Legislature a week ago, defining the relations which shall in future exist between municipalities and electric lighting companies :

14. (1) Sub-section 4 of section 566 of the said Act is amended by striking out the first six lines and article (a) thereof, and inserting in lieu thereof the following words and articles (a) to (a9) inclusive :—

By the councils of cities, towns and villages.

4. For constructing gas, electric light or waterworks, and for levying an annual special rate to defray the yearly interest of the expenditure therefor and to form an equal yearly sinking fund for the payment of the principal within a time not exceeding thirty years and not less than five years for gas or waterworks, in the case of any such city, town or village, or for electric light works, in towns having a population of 5,000 or less, as ascertained by the latest census of Canada, and in villages and not exceeding twenty years or less than five years for electric light works in cities and towns having a population of over 5,000 as ascertained by such latest census. (a) In case there is any gas, electric light or water company incorporated for or in the municipality, the council shall not levy any such special rate, or construct works for lighting the public streets, until such council has, by by-law, fixed a price to offer for the works and property of the company or companies, nor until after thirty days have elapsed after notice of such price has been communicated to the company or companies without the company or companies having accepted the same, or without the company or companies, having, under the provisions of this Act, as to arbitrations, named and given notice of an arbitrator to determine the price, nor until the price accepted or awarded has been paid, or has been secured to the satisfaction of the company or companies, and in case the company or companies and the municipality do not agree, the said price shall be determined by arbitration under this Act : And where there is more than one such company in the municipality; the arbitrators shall determine the share or proportion of the price to be paid to each company. This clause (a) shall only apply to a gas or electric light company that has supplied or shall supply gas or electric light for street lighting in the municipality, or to a water company that has supplied or shall supply water for street hydrants in the municipality.

(a2) In any arbitration under clause (a) hereof to determine the price to be paid for the works and property of a gas or water company, the arbitrators shall determine the actual value of such works and property having regard to what the same would cost if the works should be then constructed or the property then bought making due allowance for deterioration and wear and tear, and making all other proper allowances, but not allowing anything for prospective profits or franchise and shall increase the amount so ascertained by ten per cent. thereof, and such increased amount shall be the amount which the arbitrator or arbitrators shall award as the price to be allowed for the said works and property.

(a3) In any arbitration under clause (a) hereof to determine the price to be paid for the works and property of an electric light company the arbitrators shall determine the actual value of such works and property having regard : (1) To what the same would cost if the works should be then constructed or the property then bought ; (2) to the condition of the works and to any deterioration thereof from use and wear and tear or by reason of the system or appliances having become in whole or in part absolete ; (3) to the value of such works and property to the municipal corporation for the purposes, and to the extent to which the municipality can make use of the same and to such value for commercial and such other purposes as a company could use them for ; and (4) to the cost of procuring more valuable or modern improvements or appliances therefor, if any, and the cost of acquiring the right to use and of adapting such improvements, the arbitrators making all proper allowances but not allowing anything for prospective profits or franchise, and such amount so ascertained shall be the amount which the arbitrators shall award as the price to be allowed for the works and property hereunder.

(a4) Where in any of the said municipalities the municipal council desires to construct works as aforesaid to supply light for street lighting and other public uses on highways, or to supply water for street hydrants and other public uses on highways, but not for commercial purposes, the council may, by the said by-law, limit the price to be offered as aforesaid to a price for part only or for the use of part or for the purchase of certain parts and the use of other parts of the works of a company, that is to say, to so much thereof as may be required for such public uses, and in the event of an arbitration hereunder thereafter held to determine as to such offer and price, the arbitrator or arbitrators shall have power after taking into consideration the effect of severance, if any, or user on the remaining property and business of the company to award a severance of the works if the arbitrator or arbitrators shall determine that after severance, if any, or user, the company will be, in all probability, having regard to the nature of the business and all the circumstances, in a position to successfully carry on that part of their business which consists in supplying private consumers at rates not less favorable to the consumers, the company to have the right to continue to operate the balance of their works for that purpose, and if the arbitrator or arbitrators shall so award a severance, they shall by their award, determine what part of the works the municipality shall acquire for said purposes before levying the said special rate, as well as the price thereof, but nothing herein contained shall affect the right of the council at any subsequent time to offer a price for the said balance of the said works, under the provisions of this Act.

(a5) And, if within one month, after the publication of any award made under article (a) or (a4) hereof the municipality shall give notice in writing to the company that they will not accept the terms thereof, their offer may be withdrawn provided they first pay all costs of the reference and award and provided also that in the event of such withdrawal the municipality shall not, until after the expiration of two years from such withdrawal be entitled to again avail themselves of the provisions of the clause under which the award is made.

(a6) In case there is any gas or electric light company supplying gas, electric energy or light or water company supplying water in any municipality the council may, by by-law, fix a price and terms to offer for the supply by contract by such gas or electric light company of gas or electric energy or light for street lighting and other public uses, or for the supply by contract by such water company of water for street hydrants and other public uses for a term of not less than five years and not more than ten years and after thirty days have elapsed after notice of such price and terms has been communicated to the company without the company's having accepted the same the council may, under the provisions of this Act, as to arbitrations, name and give notice of an arbitrator to determine the prices and terms of the contract for such supply of gas or electric light as aforesaid, and in case the company and the municipality do not agree, the said price and terms shall be determined by arbitration under this Act.

(a7) Upon an application in writing signed by not less than five ratepayers of the municipality the council of any municipality may, at its discretion, by by-law, permit the persons making such application to use the name of the municipal corporation for the purpose of taking proceedings to determine the price at which electric light shall by supplied to inhabitants of the municipality for domestic and other purposes ; provided that no such by-law shall be passed until the persons making such application have given satisfactory security to the council to indemnify the municipal corporation against all costs which may be incurred in the arbitration proceedings. After the passing of such by-law the said applicants may, in the name of the municipal corporation, name and give notice of an arbitrator to determine the price and terms of the contract for the supply of electric light or energy to the inhabitants of the municipality for domestic and all other lighting purposes ; and for the purposes in this paragraph set forth, the said applicants so acting in the name of the municipal corporation shall have the power to do all necessary things and take all necessary steps, and their acts shall be as binding upon the municipal corporation as if the said proceedings were taken by the municipal council thereof, and in case the company and the applicants so acting in the name of the municipal corporation do not agree, the said price shall be determined by arbitration under this Act. The municipal corporation shall have the right and is hereby authorized to take proceedings by arbitration in its own name for the purposes in this sub-section mentioned, and shall have all necessary powers for that purpose whether on its own motion or when used as in this sub-section is provided.

(a8) All the provisions of this section shall apply where an individual supplies electric light or electrical energy or gas or water for municipal and public purposes. In all such cases the municipal corporation and the individuals shall proceed hereunder and be subject to the provisions hereof in the same manner as if the individuals were a company.

(29) Any municipal corporation and company or individual may agree that the official arbitrators appointed under The Act respecting Municipal Arbitrations shall determine any matters in difference hereunder, and in such case his award shall be final and binding upon the parties as if such award had been made by arbitrators appointed under this Act.

2. Article (b) of the said sub-section 4 and sub-section (7) of section 569 of the said Act are hereby amended by adding at the end thereof respectively the following words: "Or the provisions contained in any contract now existing between any municipal corporation and any company."

(3) Articles (d) and (e) of the said sub-section 4 of section 566 are amended by adding the words: "Electric light" after the word "gas" wherever the latter word occurs in the said clauses, and by inserting after the words "supply pipe" in the seventh line the words "or wires."

(4). Sub-section 5 of section 569 of the said Act is hereby amended by inserting the words "electric light" after the word "gas" wherever the latter word occurs in the sub-section 5 of the title thereof.

(5) Nothing in this section contained shall apply to or affect any by-law now in force or which has, at the time of the passing of this section, come into effect, or contract heretofore made or entered into between a municipal corporation and any gas, electric light or water company; nor shall anything in this Act contained be deemed to prevent any contract being entered into hereafter between a municipal corporation and any such company or any by-law being passed by a municipal council not inconsistent with this Act in the same manner and for the same purpose and to the same extent as heretofore.

WHEN WAS COAL FIRST USED AS FUEL.

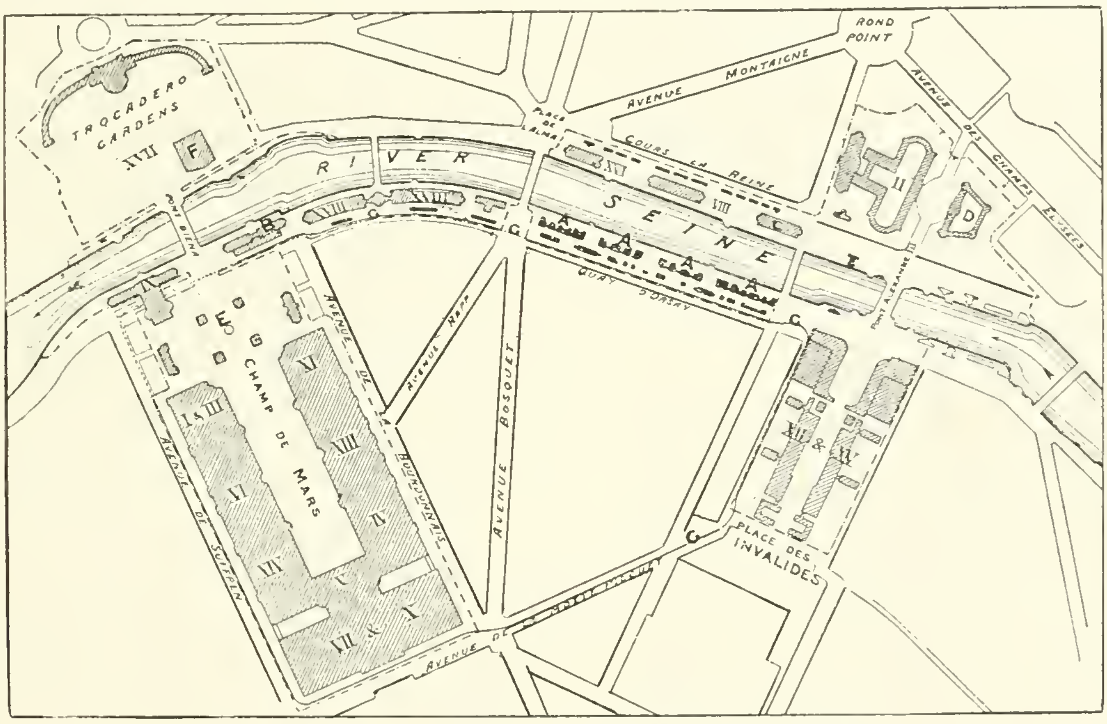
The general opinion, according to the "German Pottery and Brickmaker's Gazette," has been that coal was first used as fuel about 700 years ago, at Leige, in Belgium, but the fact is it was employed for this purpose at a much earlier date. The discovery was made on German soil in the beginning of the 12th century that the mineral we call coal was good to burn. The place where it was first obtained is exactly known; it is the present Kohlenberg, in Wurmthal. In the ancient chronicles this place was called Kalkulen, the same thing as Kohlenkull; later it was called Koalberg.

At the present time the good people of the Wurmthal call a coal mine "Kull," and the coal miner is not called a miner, but a Kohler (coaler), the common name in other parts of Germany for a charcoal burner.

The City Council of Hamilton, Ont., have appointed Campbell Leckie as engineer of the sewage disposal works.

REGULATIONS OF THE PARIS EXPOSITION.

The Canadian Commission for the Paris Exposition of 1900 have issued a booklet giving regulations, classification of exhibits, and general information for intending exhibitors. The accompanying plan, which is herewith reproduced, shows the arrangement of the Exhibition grounds and buildings, and will no doubt be found of interest. The Exhibition will open on the 15th of April and close on the 5th of November. The Colonial building will be situated on the Trocadero grounds overlooking the Champs de Mars, not far from the Great Eiffel tower, and will cover 36,000 square feet, of which 27,100 feet has been allotted to Canada.



Plan of Exhibition Grounds and Buildings—Paris Exposition.

Forms of application for space must be returned to the Canadian Commission, Department of Agriculture, Ottawa, not later than June 1st, 1899. It is the desire of the Commission to secure the best possible exhibit of Canadian goods, and there will be no charge to exhibitors for space. Accepted exhibits from Quebec, Ontario and the west must be delivered at the exhibitor's expense at Montreal or Quebec not later than November 1st, 1899, and exhibits from the Maritime provinces at Halifax, N. S., not later than November 15th. These will be shipped to Paris by the Commission free of charge. Exhibitors are expected to dispose, in Paris, of their exhibits when these have a commercial value, as only valuable collections of objects of special character will be granted free return transportation. The exhibits are divided into eighteen groups, which are again subdivided into numerous classes.

Group four includes apparatus pertaining to mechanical engineering, and is divided into three classes, as follows:

Class 19.—Steam Engines: Fire boxes, furnaces, boiler chimneys; stationary, semi-portable or portable boilers; packings and boiler fittings; feed apparatus; steam jacketing anti-fouling compounds; water softening; feed water heaters, steam driers, superheaters; steam piping, joints, cocks, piping; stationary, semi-portable and portable engines; valve gear; condensers; regulators and governors; lubricators and fittings; engines set in motion by evaporation other than that of water; methods of testing and examining steam apparatus; associations of owners of steam plants.

Class 20.—Various Kinds of Engines: Engines worked by hot air, gas, petroleum, compressed or rarified air, ammonia, carbonic acid gas; parts and fittings of such engines; hydraulic motor, wheels, turbines, water pressure engines, etc; wind mills and wind motors; gins, tumblers, spring counterweight and pedal motors, etc.

Class 21.—General Machinery: Apparatus for the transmission of power; shafting, plummer guides and slides, jointed systems; gearing; clutches, pawls; pulleys, belting and cables for transmission of power; funicular systems; governors and speed regulators; lubricators; recording instruments, engine counters, recorders, speed indicators, dynamometers, pressure guages; weighing machines; machines for testing materials, apparatus for measuring fluids and gases; machines for moving loads; cranes, lifts, etc; machines for raising water; hand or steam pumps, norias, hydraulic rams; hydraulic presses and accumulators; water pipes and accessories; air compressors and piping; ventilators; power transmission and distribution at a distance by means of water, steam, air or vacuum; apparatus and associations for preventing accidents caused by machinery.

The exhibit of electrical apparatus is placed in group five, divided into five classes, as below:

Class 23.—Mechanical Production and Utilization of Electricity: Apparatus for generating electrical currents; continuous, alternate and polyphase current dynamos; transmission of power to a distance; continuous and alternate current motors; motors with rotating fields; alteration of currents; dynamo and alternate current transformers; application of electricity to transport purposes, electrical locomotives, electric tramways; application of electricity to mechanical purposes, such as elevators, winches, cranes, capstans, traversers, machine tools, magnetic warping; special methods of wiring; safety appliances and regulators.

Class 24.—Electro Chemistry: Batteries; accumulators; plant and processes generally used in electro-plating and electrotyping; production and refining of metals or alloys; application of electro chemistry to commercial purposes, such as bleaching, sugar refining, treatment of sewage water, manufacture of soda, chlorine, chlorine of potassium, etc.

Class 25.—Electric Lighting: Use of continuous or alternate currents; arc lamps; regulators; carbons for lighting purposes; incandescent lamps; special installations for factories, public buildings and private dwelling houses; central stations; application to light houses, navigation, military engineering, public works; safety and regulating apparatus; meters; photometry; appliances for determining the intensity, distribution and illuminating power of light; special electrical appliances, such as chandeliers, candelabra, ornaments, brackets, etc.

Class 26.—Telegraphy and Telephony: Telegraphic instruments; transmitters and receivers; multiplex instruments; multiplex telegraphy; various parts; relays; repeaters, lightning conductors; speaking instruments; telephones and microphones; telephone exchanges, bells, alarums, sounders; simultaneous telegraphy and telephony; wiring for telegraphs and telephones: overhead wires; subterranean and submarine cables.

Class 27.—Various Applications of Electricity: Scientific apparatus and measuring instruments; medical electricity; electric clock-work; application of electricity to railways, mines and public works; signals; exploders; distance indicators and recording apparatus for all kinds of phenomena; electric furnaces; electric welding; electric heating apparatus.

The Riordon Paper Mills Co. of Hawksbury, Ont., are lighting their plant throughout by electricity. An order has been placed with the Royal Electric Company of Montreal for one of their 25 K. W. S. K. C. two-phase generators, wound to deliver 110 volts. There will be 200 incandescent lamps installed from this throughout their mills as well as ten alternating inclosed arc lamps. This is the fifth large mill or factory, which has within the past year installed alternating current apparatus of the S. K. C. two-phase type in preference to direct current apparatus, which the alternating current in three cases replaced, and in two cases were new plants. It shows the trend toward alternating current apparatus for all purposes, and the prediction is heard that before many months we will have alternating current street railway apparatus in use in Canada. It is already extensively used in Europe, especially in Switzerland, and the larger companies in the United States are experimenting with it and have already built a new road entirely equipped with alternating current apparatus, which is said to be giving perfect satisfaction. We may therefore in the near future have the alternating current in use for factory lighting, central station or street railway apparatus.

BLINDNESS FROM THE ELECTRIC ARC.

The danger to one's sight from the light of an electric arc, no matter whether produced for a useful purpose, or the result of some chance short circuit, should be clearly understood by every one, writes Prof. Arthur J. Rowland, in the American Electrician. This is especially true, in view of the many uses of electric arcs, besides those so familiar in the common 1,200 and 2,000 candle power arc lamps.

If one's line of vision takes in such an arc as that in the ordinary arc lamp, or that due to an accidental short circuit, or one at the break of a large current at high potential, the eye suffers a sort of paralysis, and on looking away one sees as through a fog. This effect soon passes away, and at worst requires a sojourn of a day or two in a dark room to produce a cure.

With arcs taking large currents, and especially if one electrode is metal, the effects are quite different and much more serious. At night one notices the intense brilliance and is on his guard. In daylight the contrast is not so great, and so one is more likely to suffer because of lack of care. After working with such arcs the eye does not immediately feel the effect; but after a time, perhaps hours afterward, a slight scratching is felt in the eye, as though there were some fine dust or cinders there. As time goes on, this is followed by a feeling of dryness on the eyeball, accompanied by a very profuse shedding of tears, and all the symptoms of a heavy cold in the head are felt. If the attack is a bad one, the pain becomes a very intense aching and may be accompanied by a twitching of the eyelids. In these worse attacks the afflicted one can bear no light on the eyeball, and if the eyes are opened finds he is blinded.

In case of slight attack a simple eyewash is all that is necessary for a cure. Use one made of six grains of borax in a fluid ounce of infusion of sassafras pith, or one of ten grains of boric acid in an ounce of camphor water. I can vouch for the first and have almost equal confidence in the second. In a very bad case a physician will apply cocaine, that local anæsthetic so commonly used in the eye. No one but a physician should do this.

After a few hours the pain passes away, and by keeping in a darkened room and then wearing smoked glasses for a couple of days, the eye wash being kept in use, all ill affects pass away, leaving the patient with a firm resolve to avoid further experience in this direction.

It is found that the effect of the arc has been to produce an external burn—like a sunburn on the conjunctiva, or outer membrane covering the front of the eye-ball. If one protects the eyes, this "sunburn" from the arc affects the skin; and results precisely like those after a day's outing at the seashore in midsummer are experienced.

In protecting the eyes against the burning power of such arcs it is not sufficient to simply wear such glasses as are made for those who adjust and repair common arc lights. Far too much of the light gets around them. It is necessary to use a mask covering the whole face. Even if one thinks to protect himself from all direct rays, by holding his hand before his eyes for example, there will still be likelihood of his suffering to some extent. In this way one who stops to look on may suffer from an eye trouble, the cause for which he has quite overlooked.

PERSONAL.

Mr. F. Poste has recently taken the management of the Prescott Electric Light Co.

Mr. C. F. Sise, president of the Bell Telephone Co., of Canada, is at present enjoying a brief vacation.

Mr. W. H. Browne, general manager of the Royal Electric Co., Montreal, is spending a few weeks in the Southern States with the object of regaining his health which had become impaired by a severe cold.

The death is announced of Mr. F. B. Beckett, a well known engine builder of Hamilton. The late Mr. Beckett was also interested in the Hamilton, Ancaster and Brantford electric railway project.

Mr. J. M. Campbell, President of the Gananoque Electric Light and Water Supply Co., who has been in British Columbia for the past year or two has returned to Gananoque, and will likely reside there in future.

A recent visitor in Toronto from the Pacific coast was Mr. H. Pim, the Vancouver representative of the Canadian General Electric Company. Mr. Pim came east upon one of his occasional visits to the head offices of his company. He reports a steadily increasing demand in the west for electrical apparatus.

Mr. John Inglis, of the firm of Inglis & Sons, engine manufacturers, Toronto, died suddenly in that city last week. The late Mr. Inglis came to Canada from Scotland forty seven years ago, and carried on business successively in Chippewa, Simcoe, Dundas, Guelph and Toronto. He had received the benefit of a thorough training in his native land and was recognized as being one of the most skilful men in the business. Three of his sons were associated with him in business.

Mr. E. B. Merrill, formerly lecturer in electricity at the Toronto Technical School, has recently returned from Great Britain, where he resided for upwards of two years. During the greater part of this period he was connected with the Siemens Bros. Co. He states that a number of underground electric railroads are projected in London, one of which, between one and two miles in length, is now under construction. The proposal has been made to substitute electricity for steam on the main lines of the underground railway system which has served the central part of the city for a number of years past. One of the principal objects in view in making this change is to get rid of the sulphurous fumes and soot which are the unpleasant accompaniments of the present system.

TRADE NOTES.

It is rumored that the Smith's Falls Electric Light Co., and the Smith's Falls Power Co., will be amalgamated.

We are advised by Mr. Edward Slade, electrical contractor and engineer, Quebec, that in future his business will be carried on under the name of The Slade Electric Co., with offices and show rooms at 137 John street.

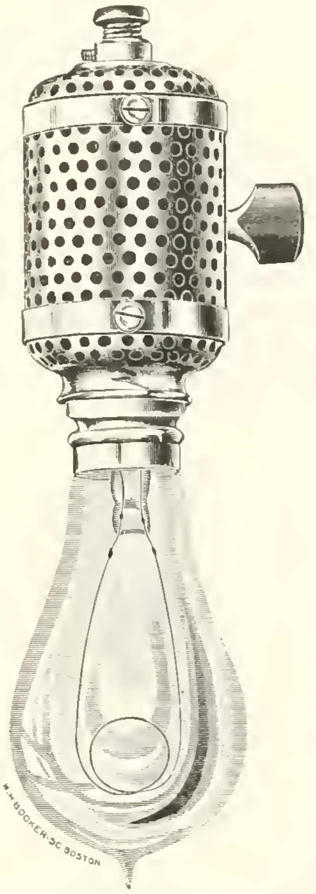
A new descriptive and fully illustrated catalogue and price list has recently been published by the Weston Electrical Instrument Co., of Newark, New Jersey, the well known manufacturers of standard recording instruments.

The corporation of the town of Joliette, Quebec, are extending their arc system and have placed their order with the Royal Electric Company for one of their 50 light 2000 c. p., T. H. royal arc machines with a full equipment of lamps. This is an addition to their recent purchase of an 120 k. w. S. K. C. generator with transformer, etc., which was started in operation two weeks ago.

The Consumers' Cordage Co., of Montreal, are fitting out their entire factories with electric power and have placed their order with the Royal Electric Co. for two 50 h.p. S. K. C. synchronous motors. The current for these motors is to be furnished by the Chambly Mfg. Company as soon as they have their current in the city, which is expected about the first of May.

The Esquimalt & Nanimo Railway Co., who are opening up their coal mines at Oyster Harbor, B. C., have decided to operate the entire mining and hauling apparatus by electricity, and for this purpose have placed their order for two direct connected units of 150 h.p. each, with Ideal engines and two 40 h.p. mining locomotives with switchboards and all the necessary supplies for the complete installation, with the Royal Electric Co., of Montreal. This is the second order that the Royal Electric Co. have received for mining locomotives and apparatus on Vancouver Island.

THE BRUNT REGULATING SOCKET.



BRUNT REGULATING SOCKET.

THE Packard Electric Company, of St. Catharines, Ont., in conjunction with their general agent in Montreal, Mr. R. E. T. Pringle, have recently placed upon the market the Brunt regulating socket, which they advertise to control an incandescent lamp in its radiation of light in the same manner as a gas jet is ordinarily controlled. The socket, illustrated herewith, admits of five conditions of light, with a positive saving, it is claimed, of current at the different stages, as specified below:

Assuming a 16 candle 64 watt lamp is used, the first contact in the socket will give 16 candles at 64 watts; then by simply turning the key through an arc of 180 degrees, the light is diminished from 16 candles to 2 candles and the watts diminished from 64 watts to 27 watts; the intermediate stages of light consuming respectively 60, 52, 45, 37 and 31 watts. The socket is adapted to either direct or alternating current, the latter of any frequency; and it is also adapted to any voltage from 50 to 118. The construction of the socket renders it practically indestructible, being operated upon an entirely new principle.

These sockets have been found useful as night lamps in vestibules, hallways and sleeping apartments, and especially desirable for the sick room.

ELECTRIC LIGHTING AT WINNIPEG.

A tender was recently submitted to the city Council of Winnipeg by the Winnipeg Electric Street Railway company through H. J. Somerset, superintendent, for street lighting, at rates per light per night as follows: 10 years 175 to 250 lights, 29 cents each; 5 years, 150 to 200 lights, 34 cents; 5 years, 200 to 250 lights, 32 cents; 3 years, 150 to 200 lights, 39 cents; 3 years, 200 to 250 lights, 37½ cents. All lights to be 2,000 nominal candle power, each developing an electrical efficiency of 450 watts, and to be of the most recent type of lamps, such as the "Brush Improved," "Adams' Bagnall," or focusing lamps, as may be decided by the city, with the right only to use the lamps at present in use, so far as they are found in a satisfactory condition and subject to specifications, which will in every way meet the public requirements. Mr. Somerset wrote: "In order to bring the company's power house and generating system to a strictly up-to-date standard as the council are aware, the company is expending a large sum of money, and in order to establish the lighting system tendered for further large expenditure will be necessary and the company feel that with their modern system and facilities they are in a better position than the city would be for furnishing a satisfactory lighting service. It is the intention of the company to meet the views of the council in every reasonable way and if awarded the contract to furnish a first class service in every respect."

THE AMERICAN STOKER.

THE American stoker shown herewith offers the steam-using world a most thoroughly practical method for the economical use of coal.

Not only is a great saving effected in the actual amount of coal used, but the apparatus provides at the same time a practical and efficient means of smoke prevention. In this connection we show two views of the Dominion Cotton Company's mills at Montreal, that will be studied with interest by our readers.

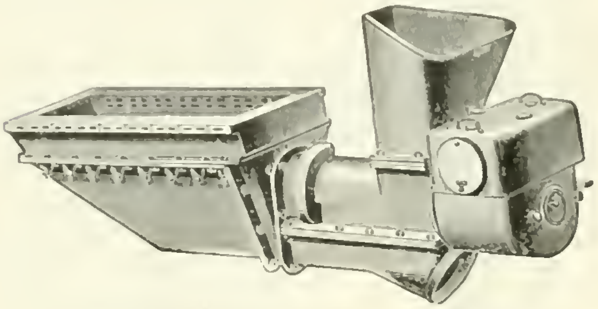


FIG. 1.—AMERICAN STOKER READY FOR INSTALLATION.

Fig. 2 is a reproduction of a photogragh taken July 22nd, 1898, at 10 a.m. before the American stoker was put in, while Fig. 3 shows a view of the same chimney taken Sept. 9th following, at the same hour, with the whole of the steam plant of 700 h.p. in operation, the boilers fired by means of the American stoker, using soft coal screenings.

These photographs were taken without the knowledge of any one connected with the cotton mill, and show in a striking manner how effectually the vexatious "smoke nuisance" question may be settled by the use of this type of mechanical stoker.

The principle upon which the American stoker operates practically reduces the coal to gas and coke and insures complete combustion. Immediately beneath the coal hopper, and communicating with it, is the conveyor pipe; this in turn communicating with the coal magazine. A screw conveyor or worm is located in the conveyor pipe and extends the entire length of the magazine. Immediately beneath the conveyor pipe is located the wind box, having an opening beneath the hopper. At this point is connected the piping for the air supply, furnished at low pressure by a volume blower. The other end of the wind box opens into the air space between the magazine and outer casing. The upper edge of the magazine is surrounded by tuyeres, or air blocks, these being provided with openings for the discharge of air, inwardly and outwardly. Each stoker is driven independently by a small steam motor, located immediately in front and beneath the hopper. The motor has a simple reciprocating piston. Its piston rod carries a crosshead, which, by means of suitable connecting links, operates a rocker arm having a pawl mechanism, which in turn actuates the ratchet wheel attached to the conveyor shaft. The stoker is thus entirely self-contained and complete in itself, and consequently there is no danger of the driving and feeding mechanism (the only working parts) ever getting out of alignment.

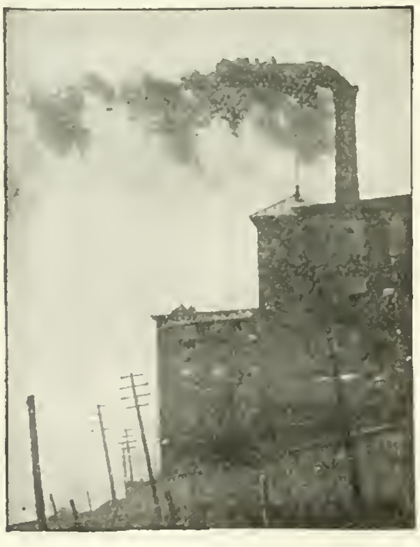


FIG. 2.—PHOTOGRAPH OF CHIMNEY BEFORE THE AMERICAN STOKER WAS INSTALLED.

The rate of feeding coal is controlled by the speed of the motor, this being effected by the simple means of throttling the steam in the supply pipe to the motor.

The shields covering the motor effectually protect the mechanism from dirt and dust.

The coal is fed into the hopper, carried by the conveyor into the magazine, which it fills, "overflows" on both sides, and spreads upon the sides of the grates.

The coal is fed slowly and continuously, and, approaching the fire in its upward course, it is slowly roasted and coked, and the gases released from it are taken up by the fresh air entering through the tuyeres, which explodes these gases and delivers the coal as coke on the grates above.

The continuous feeding gives a breathing motion to this coke bed, thus keeping it open and free for the circulation of air. Particular attention is called to the fact that every pound of coal fed into the hoppers passes through this gas-making process, and there is no loss of coal through grates, by reason of the use of dead grates in the furnace, in place of open grate bars.

The non-combustible is taken from the furnace in the shape of vitrified clinker. There is practically no soot, and with these results it is obvious that the combustion must be extraordinarily good.

The finest of slack coal can be used with the American stoker; it can also handle lump coal, as any lump that can be fed into the hoppers will be crushed by the conveyor, there being provided a set of teeth, placed at the mouth of the conveyor, against which the coal is squeezed and broken.

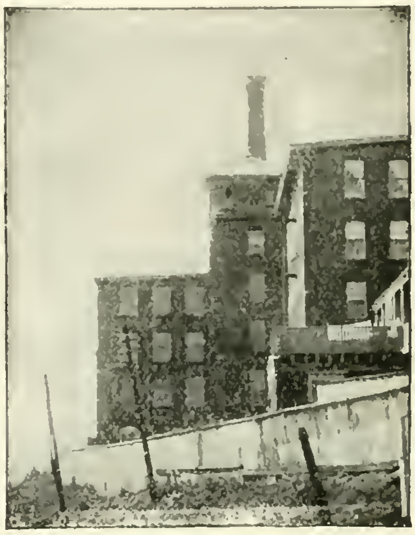


FIG. 3. THE SAME CHIMNEY AFTER THE AMERICAN STOKER WAS INSTALLED.

The American Stoker Company is located in the Washington Life Building, New York City. It has Canadian offices at 54 Street Railway Chambers, Montreal.

Since equipping the Dominion Cotton Co.'s mill, four other mills belonging to the same company have been equipped with the American stoker. In addition thereto the American Stoker Company have put their apparatus into a number of other prominent mills in Canada, among them being the British Columbia Sugar Refinery, St. Lawrence Sugar Refinery and one of the plants of the Canadian Pacific Railroad.

A large number of notable plants in the United States are now employing the American stoker. Further particulars with handsomely illustrated catalogue may be obtained by addressing the manufacturers.

The town council of Whitby has given a five years contract to the local electric light company for 27 arc lights at $1,000 a year. The council refused to entertain the request of some of the citizens to take tenders for the purchase of a civic plant.

For the first time in the history of the English Institution of Electrical Engineers a woman has been invited to read a paper at one of its meetings. Mrs. Ayrton, —the wife of Professor W. E. Ayrton, F. R. S., professor of applied physics in the Central Technical College of the City and Guilds of London Institute—has just read a paper on "The Hissing of the Electric Arc" at the meeting of that body. She has carried out a series of original investigations on the electric arc, and has contributed many papers on the subject.

SPARKS.

An electric plant is being installed in the Fort Saskatchewan Milling Co's. mill, N. W. T.

A scheme is mooted at Chilliwack, B. C., to purchase an electric light plant for lighting the town.

Mr. Geo. Stitt, of Cardinal, Ont., has invented a device to regulate the light of an incandescent lamp.

The Protestant School Commissioners of Montreal have decided to fit Mount Royal school with electric clocks.

The bill incorporating the Nova Scotia Electric Light Co., has reached an advanced stage in the Legislature.

The village of Nelson, B. C., is now in possession of its electric plant, having purchased it from the Electric Lighting Company.

The Canadian Water Power Company of Quebec, want a manager for their works now being constructed at Chaudiere Falls, near that city.

The annual meeting of the Amherstburg Electric Light, Heat and Power Company was held last month, at which the old officers were re-elected.

It is improbable that the proposed extension of the Ottawa Electric Railway from Rockliffe Park to the rifle range will be carried out this summer.

Mr. Saxby, of Kingsville, has submitted a proposition for electric lighting to the council of Bradford, Ont. He proposes to install a plant to cost about $8,000.

Mr. M. Martin has applied to the town council of Wallaceburg, Ont., for permission to erect poles and wires for the purpose of operating an incandescent lighting plant.

The city surveyor of Montreal has been requested to report on the feasibility of placing underground electric wires in Craig street from St. Lawrence to St. Antoine street.

The Anglo American Power Company, which was refused permission to lay underground wires in the city of Toronto, has asked for another conference with the Board of Control.

Mr. R. E. T. Pringle, Electrical Supplies, 216 St. James st., Montreal had his stock damaged somewhat by water during the fire which recently took place in Bett's restaurant, next door.

A by-law will probably be submitted to the ratepayers of Rat Portage, Ont., to raise the sum of $40,000 to purchase a half interest in the Citizens' Electric Light and Telephone Company.

On the 20th of this month the ratepayers of Winnipeg will vote on a by-law to install a municipal lighting plant. Tenders for the supply of the plant are invited by C. J. Brown, city clerk, up to the 17th inst.

The Pontiac Telephone Company are offering for sale their rights and plant, the line being about sixty miles in length. Tenders for purchase are to be addressed to F. C. Dezouche, Bryson, Que., by April 15th.

The Hamilton Electric Light and Power Co. are negotiating with the city of Hamilton for a renewal of its lighting contract. If given a ten years franchise, the company will spend about $100,000 in improving the system.

An arrangement seems likely to be made by the corporation of Gravenhurst for the purchase of the electric lighting plant now owned and operated in that town by Mr. Fletcher, who has offered to sell at the price of $10,500.

According to Mr. Hugh McCutcheon, Collector of Customs at Nakusy, B. C., a Toronto syndicate has purchased mineral springs near that place and intend building a $50,000 sanitorium, to be equipped with an electric light plant.

Frank Tushingham, an engineer at the power house of the Toronto Street Railway, recently had his left arm torn off at the elbow. Tushingham was repairing one of the pumps, when it started suddenly, resulting in the accident.

Buffalo capitalists are said to have decided to build an electric railway from Fort Erie, Ont., to Point Abino, a distance of thirteen miles, and to Chippewa, from which point an electric road runs along the Canadian side of the river to Queenston.

Mr. S. R. Ickes, of Harrisburg, Penn., was in Woodstock, Ont., recently, negotiating with the Council and Board of Trade regarding the construction of an electric railway to connect that city and Ingersoll. He proposes to locate the power house at Beachville, about midway between the two places.

News has reached Toronto that the city council of Birmingham, Eng., have decided, by a vote of sixty to one, to take over the street railway at the expiration of the Mackenzie-Ross franchise and operate it as a department of the municipal service. Mr. Granville C. Cunningham, formerly city engineer of Toronto, is manager of this road, which a few years ago was converted into an electric system.

Mr. E. A. C. Pew, is again to the front with his proposed power canal scheme. He states that the necessary capital has been subscribed for its construction and that the contracts will be let at an early date. The canal is intended to extend from the Welland river, two and one half miles below Wellandport, to the Jordon river, the power to be developed at what is called Ball's Falls.

The West Kootenay Power and Light Co., of Rossland, B. C., are experiencing a large demand for light and power. They are at present lighting up the shaft of several large mining properties, and are operating with complete success one of the largest electrical hoists ever installed. The hoist is designed to lift 12,000 lbs. at a speed of 800 feet a minute, and is driven by a 300 h. p. induction motor.

An engineer named Germain, in the French ministry of Posts and Telegraphs, has brought out an invention which he claims will revolutionize the telephone. By an ingenious adaptation of the telephone wire, the microphone is made to develop and intensify the vibration received, so that conversation can be carried on between two persons, both of whom may be several yards distance from the instrument.

The St. John Street Railway Company has been ordered by the court to pay $25,000 as damages to Professor Hesse. The professor was organist of the Roman Catholic Cathedral in Providence, R. I., and received injuries while a passenger on a car of defendants which necessitated the amputation of his left foot, and rendered him incapable of performing his duties as organist. The Street Railway Company will probably appeal the case.

According to the statistics issued by the Treasury Department of the United States, there were imported into Canada from that country during the fiscal year ending June 30th, 1898, electrical apparatus and instruments to the value of $300,530. Of this sum Nova Scotia and New Brunswick were represented by $24,566, Quebec and Ontario by $254,182 and British Columbia by $21,482. the total exports of electrical apparatus from the United States for that period were $2,770,803.

A bill passed the Ontario Legislature at the recent session containing an agreement between the corporation of the town of Peterboro and the Peterboro Electric Light and Power Co. The bill provides that the town may supply electric light and heat for municipal purposes only and power for all purposes except commercial and private lighting, and should it engage in these undertakings, it must purchase by agreement or arbitration the street lighting plant of the company.

The Metropolitan Electric Co., of North Toronto, are building a first-class power station of 1,000 h.p. capacity at Bond Lake, to supply current for the operation of that portion of their system now under construction, extending from Richmond Hill to Roach's Point on Lake Simcoe, as well as the proposed new line under survey to Schomberg and Tottingham. The company propose to establish picnic and camp grounds at Bond Lake, for which object they have purchased two hundred acres of land.

It is definitely announced that the Trenton Electric Company and the Trenton Water Company have amalgamated, under the name of the Trenton Electric and Water Company, Limited. An arrangement has been entered into with the town of Trenton whereby the new company is given entire control of the town's water power, including the privilege of transmitting power to outside points. The new company will proceed at once to construct a transmission line to Belleville, and intend doing their own construction work.

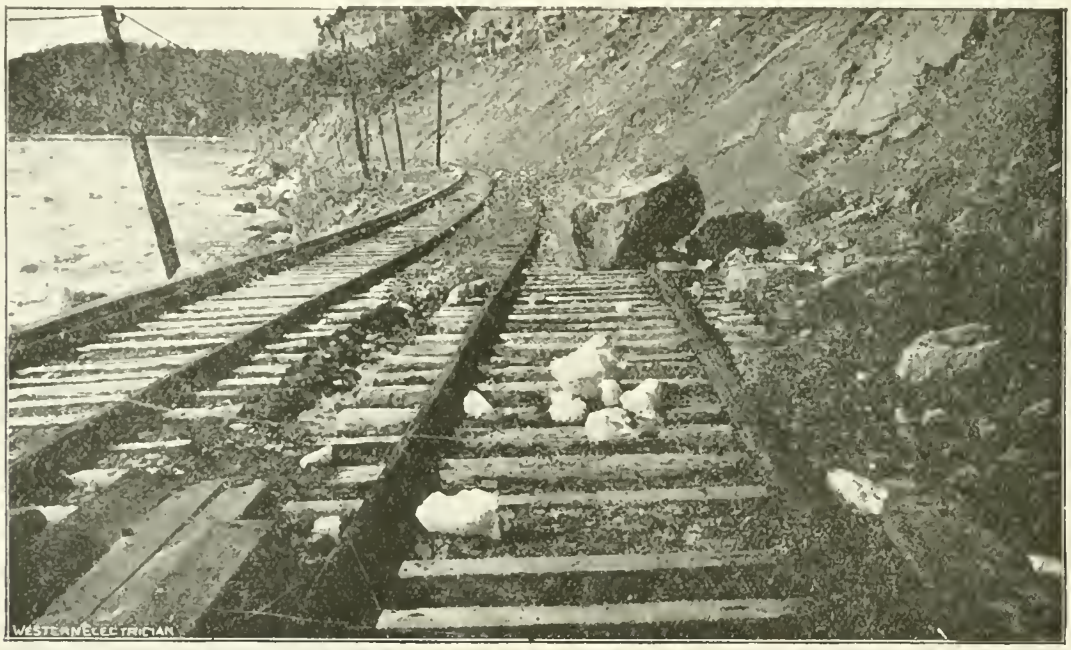
Mr. Chas. Brent, M. E., of the Rat Portage Metallurgical Works, has recently pointed out the fact that electric power might advantageously be supplied to and employed by the mines located within a radius of twenty-five miles of the water power at Rat Portage. He points out that in winter especially electric hoists possess a distinct advantage over steam hoists, as the use of steam when the thermometer is 40 degrees below zero is attended with many difficulties. This also applies to diamond drill work both on surface and underground. Mr. Brent estimates that electric power can be supplied at less expense than for plant, and at half the cost of steam power. In this connection the Rat Portage Reduction Works are being equipped with motors to which current will be supplied at a cost of $8 per day of twenty four hours for 75 h. p.

ELECTRIC RAILWAY DEPARTMENT.

THE NIAGARA GORGE ROAD.

The accompanying illustration shows the present condition of the Gorge electric railway at Niagara, which recently passed into the hands of a receiver. The expense of maintaining the road in running condition, coupled with the shortness of the season during which a paying traffic might be counted upon, were the chief causes which brought failure to the enterprise. It is reported that the road will pass into the hands of the syndicate which is said to have recently secured control of the Buffalo street railway and the electric railway lines tributary to that city, including the Niagara Falls Park and River Railway.

Doubtless the promoters of this deal have in view the great exhibition which is to be held in Buffalo two years hence, which should provide a tremendous business for these electric roads and make handsome profits for the owners. The Gorge road could no doubt be made to pay as a part of such a system, but a considerable expenditure must be incurred if the lives of passengers are to be safeguarded. Some means is required of protecting the roadbed, cars and passengers from the masses of rock which are constantly loosening and tumbling down from the embankment, as shown in the illustration.



The Niagara Gorge Road.

A NEW ELECTRIC RAILROAD AT QUEBEC.

The line of railway between Quebec and St. Anne de Beaupre (the seat of the celebrated religious shrine visited yearly by thousands of pilgrims), which has hitherto been operated by steam, is to be transformed into an electric road. A contract has been given to Messrs. Ahearn & Soper, of Ottawa, for the necessary equipment.

The generating apparatus consists of one 600 k.w. AC. DC. Westinghouse generator, two 300 k.w. Westinghouse self-cooling step-up transformers, complete switchboard for generating station, one 200 k.w. Westinghouse rotary transformer, two self-cooling transformers, complete sub-station switchboard. Also 25 cars, which will be manufactured at Ahearn & Soper's car works. Some of the cars will be equipped with 12-A 30 h.p. Westinghouse motors, and some with 38-B 50 h.p. Westinghouse motors. The long cars, which will be used between Quebec and St. Anne de Beaupre, will each be equipped with four Westinghouse 50 h.p. motors.

AN UNDERGROUND ELECTRIC RAILWAY.

A correspondent of the Toronto Globe thus describes an electric trolley line which he discovered in operation in a British Columbia mine: "On the other side of the shaft is the electric trolley, which is gradually displacing, though it cannot entirely supersede, the ubiquitous mule. The track is three miles in length and the accommodation not as enticing as that provided by the Toronto Railway Company. It would compare unfavorably even with the style of Sir Frank's regime, but what it lacks in display it makes up in speed. A bag of shavings on the bottom of a rattling, jolting, roaring and rocking box car makes an excellent seat. The guide has similar accommodation in the car behind, and then comes a long train of noisy empties. Beyond the three empties in front is the engine, lit by an incandescent globe and the light in the motorman's hat. Sometimes it disappears around a sharp curve, but the rattling, jolting cars chase after and bring it into view. The great weight of rock above is sustained by a succession of upright and cross timbers, making a continuous arch above the rushing train. Sometimes the timbers, which seem to be flying past overhead, descend close to the top of the engine and the motorman lowers his head for safety. An electric shock threatens the head that rises against the wire, and a more substantial shock is awaiting the head that rises anywhere else. But without any printed warnings to passengers both heads and arms are kept out of danger. Speed slackens, the arch grows wider, the cars jolt over a switch and come to a standstill. It is the siding where the returning train of full cars must be passed, and already the rumble of them can be heard. The guide comes forward with the caution to look out for the overhead wire, and explains that we are almost directly under the big sailing ship we saw in the harbor loading coal. Between us and the vessel's keel is 600 feet of rock and 30 feet of water. The engine comes into sight around a curve, and whirls rapidly past with a long train of loaded cars for the shaft. When the track is cleared the guide returns to his bag of shavings and the deafening rattle of the empty cars is resumed."

ELECTRIC TRAMWAYS IN THE LAKE ST. JOHN REGION.

In a report submitted to the Department of Woods and Forests of the Province of Quebec, Mr. J. C. Langelier points out the immense possibilities of the Lake St. John region for the manufacture of pulp and paper. The development of this industry will, he thinks, result in the construction of electric tramways, concerning the outlook for which he says:

"There is probably no other place where electric railways could be built under such exceptionally advantageous conditions. In addition to the fact that the ground is level and building timber right on the spot, there would be all along the line, at comparatively short intervals, water powers capable of giving an unlimited supply of electricity. Starting from the west there are the Mistassini falls, and a mile further those of the Mistassibi; nine or ten miles further to the east the White Falls on the Little Peribonca; nine or ten miles still further east, the falls of the Great Peribonca. From these falls to those of the Little Discharge, there is a distance of less than twenty miles. At the same distance from the Little Discharge are the falls of the au Sable river, 249 feet high. Six miles further and a dozen miles from St. Alphonse is the Chicoutimi river, which could also supply power for producing electricity.

It would be equally easy to establish an electric line between Mistassini and Roberval, the western terminus of the Quebec and Lake St. John Railway. From Mistassini to the Chamouchouan, there is barely more than sixteen miles, and about midway the Tecouapee river could supply water-powers capable of providing an abundance of electric power.

On the Chamouchouan the Bear falls could be utilized for the same purpose. From the Bear falls to Roberval, a distance of about 30 miles, the Salmon, Iroquois and Ouiatchouaniche rivers, nearly at equal distance from one another, also have water-powers capable of supplying the electric power required for a tramway.

The construction of an electric tramway between Montreal and Roberval, a distance of about 250 miles could be effected under the most favorable conditions. The summit to be got over or the difference of level between the two places is about 725 feet instead of 1,300, and even more on the Quebec and Lake St. John Railway. There would only be two bridges at all costly, those of the rivers des Prairies and St. Maurice.

From Bou de l'Ile to the river Mastigouche, a distance of about fifty miles, there would be only the water-power obtained by damming the river L'Assomption for producing electricity by hydraulic power; but from Mastigouche, whose rapids and cascades could develop considerable motive-power, there are the falls of the river a la Chienne, one 200 feet, the other 75 feet high, the rapids of the Pabelognang and of the Vermilion, whose course is nothing but a series of cascades and falls; beyond the St. Maurice are the falls of the river Trenche, six miles from its mouth; those of the river Croche, those of the river Ouiatchouaniche, which falls into Lake St. John at Roberval village. Finally, from the Mastigouche, a distance of a couple of hundred miles, water-powers capable of supplying an electric railway are not at greater distance from one another than 25 miles, so that there is no place where the current would have to be transmitted more than 25 miles.

The traffic supplied by the paper mills would suffice to assure the success of such a railway, but there will also be many other sources, as it would serve to supply the great lumbering establishments on the Upper St. Maurice. It would likewise develop the settlements in the valley of the Mattawan, especially in the rich and fertile territory between the rivers Trenche and Croche, where there are nearly a million acres of the best farming lands, with a climate more favorable for farming operations than that of the neighborhood of Three Rivers."

McGILL UNIVERSITY NOTES.

The sessional lectures at McGill University have been finished, and examinations are now being held.

A considerable quantity of apparatus for the new equipment of the Department of Electrical Engineering of McGill University has been received during the past month.

The installation of a new electric elevator in the Engineering Building of McGill University is being considered. The building will also be entirely re-wired during the summer.

Professor R. B. Owens lectured before the Natural History Society of Montreal on the evening of March 30th, on the subject of "Water Power Development." Professor Owens leaves tor England about the end of the present month, and will return before the commencement of lectures in the fall.

Victor Turbines

OPERATING DYNAMOS

That there are more **Victor Turbines** in use supplying power for electric generators than any other, is due to the many points of superiority possessed by this Turbine.

FEATURES WORTH REMEMBERING

High Speed, Close Regulation, Great Capacity, High Efficiency, Perfect Cylinder Gate, Steady Motion

RECENT PLANTS INSTALLED:—Lachine Rapids Hydraulic & Land Co., Montreal, Que., 12,000 h.p.; Chambly Manufacturing Co., Montreal, Que., 20,000 h.p.; West Kootenay Power & Light Co., Rossland, B.C., 3,000 h.p.; Dolgeville Electric Light & Power Co., Dolgeville, N.Y.; Honk Falls Power Co., Ellenville, N.Y.; Hudson River Power Transmission Co., Mechanicsville, N.Y.; Cataract Power Co., Hamilton, Ont.

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SPARKS.

The electric car shops at Ottawa were recently damaged by fire to the extent of $12,000.

It is reported that a company is being formed to introduce electric vehicles in Vancouver.

The Chicoutimi Water and Electric Co. are applying for a charter, with a capital stock of $125,000.

Incorporation has been granted to The Electric Boiler Compound Co., Limited, of Guelph, capital $15,000.

Mr. S. W. Bradley formerly of the Hull Electric Railway, is the new manager of the Cornwall Electric Street Railway.

Mr. Thomas Potter, electrician, of Walkerton, recently received a severe shock by accidental contact with a live wire.

Negotiations are said to be in progress for the purchase by an English syndicate of the Belleville Electric Railway. If the deal goes through the road will probably be extended.

It is announced that the Eugene Munsell Co., of New York, are about to establish at Ottawa extensive works for preparing mica for a variety of purposes.

Mr. Frank Postlethwaite, electrical and mechanical engineer, died in Toronto a week ago from consumption. He was a graduate of Illinois University.

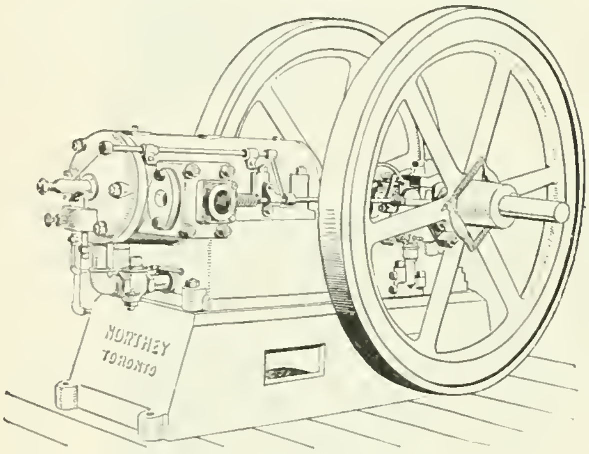
The corporation of Orillia have agreed to accept water wheels manufactured by the Jenckes Machine Co., of Sherbrooke, to generate current for the proposed long distance electric transmission system.

Ald. Morris recently questioned the quality of the light supplied by the Ottawa Electric Co. The company claim that there has been no deterioration in the quality.

A bill has passed the Ontario Legislature incorporating a company to construct an electric railroad from Smith's Falls by way of Gananoque to Merrickville.

Prof. J. T. Nicholson, whose paper before the Institution of Civil Engineers on the temperature within the cylinder of the steam engine, attracted widespread attention a year ago, has resigned his position as head of the Mechanical Engineering Department of McGill University. Prof. Nicholson has been appointed to take charge of the Mechanical and Engineering Department at the new Municipal Technical School, Manchester, England.

Professor R. B. Owens has reported favorably on the plans of the Metropolitan Electric Co., for the development and transmission of electric power to the city of Ottawa. His report states: "From an engineering standpoint you have a power exceptionally easy of development, and its electrical transmission and distribution to and in the city of Ottawa presents no particular difficulties, and can be cheaply and efficiently done as compared with other similar plants now in operation. Considering the short length of line and the probable mixed nature of the load, consisting of both lights and motors, two phase distribution is probably advisable." The contract for the development works at Brittania has been awarded to Messrs. Brewder& McNaughton, of Ottawa. The work is to be completed by the 15th of November next.



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MARITIME ELECTRICAL ASSOCIATION

Proceedings of the Second Annual Convention

THE second annual convention of the Maritime Electrical Association was held, pursuant to announcement, at the New Victoria Hotel, Halifax, on Tuesday, April 18th. The Executive Committee met at 9 a.m. to transact business relative to the admittance of new members to the Association and its financial condition.

The opening session of the convention was held at 10 a.m., with the President, Mr. F. A. Bowman, in the chair. There were present the following members :

F. A. Bowman, superintendent New Glasgow Electric Co., New Glasgow ; J. H. Winfield, eastern superintendent N.S. Telephone Co., New Glasgow ; G. N. McDonald, electrician, Moncton, N. B.; S. G. Chambers, president Chambers Electric Light & Power Company, Truro ; P. R. Colpitt, city electrician, Halifax ; F. A. Huntress, manager Halifax Tramway Co. ; J. W. Crosby, electrician Halifax Tramway Co.; I. H. Smith, representative Canadian General Electric Co., Halifax ; G. C. Siebert, Maritime Electric Co., Halifax ; R. T. MacKeen, representative Halifax Tramway Co.; F. A. Hamilton, electrical engineer, Halifax; W. Luke, Halifax Tramway Co.; P. A. Freeman, chief engineer Halifax Tramway Co.; James Graham, electrical contractor, Halifax; C. E. Harris, manager N.S. Telephone Co., Halifax; J. D. Briggs, superintendent N.S. Telephone Co., Halifax ; A. Miller, electric light inspector, Halifax ; E. Souliss, Bedford Electric Co., Halifax ; J. A. Anderson, electrician John Starr, Son & Co., Halifax ; W. N. Pickles, electrical contractor, Halifax; J. L. MacDonald, Halifax Tramway Co. ; W. A. Winfield, Windsor, N.S.; H. P. Archibald, B.A.Sc., Wolfville, N.S.; W. L. MacDonald, Moncton, N.B.

MR. F. A. HUNTRESS,
President, Maritime Electrical Association.

After a few opening remarks, the President called upon the Secretary to read the minutes of the last meeting, held in Halifax September 27th, 1898. Upon motion the minutes were adopted.

The President then delivered his annual address, as follows :

PRESIDENT'S ADDRESS.

We have now passed through the first year of our existence, and have found out what are our powers and what our limitations. We held a convention during exhibition week last September, which was a fairly successful one, and would have been much more so had not the weather interfered with it, as it did with pretty much all arrangements of that week. In spite of this, one of the objects of the Association was distinctly advanced by the meeting. Several of the out of town members made the acquaintance of each other and the town members.

One feature of this meeting was most valuable, and will, I hope, be repeated this time. Several matters were brought up and discussed that were of direct interest to the members present, and personal experiences on these were freely exchanged. With a view to encouraging this, we issued a circular to the members, asking if there were any questions that they would like to bring forward. The response to this request was not as full as I would like to have seen, but we must not expect too much at first. We have a few questions that will be introduced for discussion as opportunity arises, and I hope that some of those who did not answer the circulars have brought questions with them, and will bring them up for discussion.

It is the discussion of the smaller and more local issues that I wish to encourage in this Association. As I think I have said before, we can depend on the larger associations and the technical journals to furnish us with valuable papers on the main principles of the industry. We should, therefore, devote our attention more to smaller details. The best way to do this is to get the members to feel that they can bring up any subject on which they want information and advice. As with our comparatively small numbers we shall very soon be all personally known to each other, our meetings should not take on a too stiff and formal aspect, but each one should feel at home and as free to say much or little as they would in a group gathered in the hotel smoking room. I will, therefore, ask you, one and all, to note any difficulties you may meet with or special methods you may use in your work, and either write them out in a few words and present them at a meeting, or, if you are really too diffident to do this, write a note to the Secretary and give him the idea, and it will be brought up at the meeting, with your name mentioned or not, as you may wish. I spoke at some length on this matter at the September meeting, and I must plead as my excuse for repeating it now its vital importance to the welfare, not to say the actual continued existence, of the Association.

The executive and the Halifax members have striven to make this meeting a thorough success, and it is hoped that it will result in awakening a thorough interest in the Association throughout the maritime provinces. I wish right here to thank the Halifax members for the lively interest they have taken, and the strenuous efforts they have made to make everything pleasant and attractive. Under the able leadership of our Vice-President, Mr. Colpitt, they have prepared a programme of papers and social entertainment that should cause this meeting to be long remembered.

Steady progress has been made in the electrical industries in these provinces during the past year. While we cannot expect to see the very large transmission schemes undertaken among us just at present, some smaller ones have been well worked out on modern lines, and some steps have been taken in connection with larger projects. All this going to show that our people have grasped the great possibilities of electrical power.

Among the many steps in advance that the industry has made during the past year, one that should be most seriously studied by the smaller stations is the question of forced draft in the furnaces. While this matter has been coming steadily to the front for some years, it has lately been pushing itself into notice most markedly. Some remarks on this subject were made at our meeting last September that showed that our members were studying the subject and stand ready to adopt new ideas when it becomes apparent that they will pay. I hope that further information may be brought out at this meeting from those who have had practical experience in this matter or who have given it study.

F. A. Bowman, President.

Mr. Hamilton expressed his pleasure in listening to so able an address. In the course of his remarks he also stated that the suggestions made by the President were good. After some fitting remarks upon the zeal and untiring efforts displayed by the President during his term of office, Mr. Hamilton moved that a vote of thanks be tendered Mr. Bowman. This was seconded by Mr. Colpitt and heartily approved of by the members.

Mr. P. R. Colpitt,
Vice-President Maritime Electrical Association.

The President, replying, expressed his thanks to the meeting. He felt that he had done what he could, being hampered to a large extent in his duties on account of living at such a distance from the majority of the members. In the course of his remarks he again referred to the advisability of electing the members resident in Halifax to the offices of president, vice-president and secretary, also suggesting that a sufficient number of Halifax members be elected to the executive committee that a quorum could be formed at short notice, if necessary, without difficulty.

The Secretary then read his report, as follows :

REPORT OF SECRETARY-TREASURER.

At the meeting of organization held last April in Halifax, we had the names of fifty-six persons who were interested in the formation of this Association and had expressed their wish to become members. That meeting was a success, and the prospects seemed good for the formation of a very useful society. Since that time every effort has been put forth by the officers to further increase the membership list, though apparently with not any great degree of success. Circulars of information have been sent to all persons in the province (whose names we could obtain) that were eligible for membership. Only three new members have been added during the year, but we trust that our efforts have at any rate broken the ground, and that the fruits of our labors will appear later. Two meetings of the Executive Committee were held during the year, and various plans were discussed for rendering the Association of as much value as possible to its members. The following statement will show the financial condition of the Association at the close of the year, March 31st, 1899:

RECEIPTS.

46 membership fees at $2	$92.00

EXPENDITURE.

Rent of room for meeting, April, 1898	$ 5.00
Books, etc., for Secretary	4.35
Membership certificates	6.20
Printing	34.50
Rent of room for meeting, September, 1898	5.00
75 copies of report of meeting, September, 1898	3.75
Expressage and telephone	1.50
Postage	10.00
Cash in hand	21.70
	$92.00

The total membership list at the close of the year was 59. There were four new members elected at the executive meeting this morning, bringing the number up to 63. There are thirteen fees for last year still remaining unpaid.

J. H. Winfield,
Secretary-Treasurer.

Mr. Anderson moved, seconded by Mr. Chambers, that the report be adopted, which was carried.

A short time was then devoted to a general discussion as to the standing and financial condition of the Association, the general opinion being that, although the record of the Association during the past year had not been particularly bright, yet the present year promised better success.

The election of officers for the ensuing year was then proceeded with.

For the office of President, Mr. Chambers nominated Mr. P. R. Colpitt, of Halifax, the retiring vice-president.

Mr. Colpitt, however, feeling that it would be impossible for him to accept the position, nominated Mr. F. A. Huntress, of Halifax, for the office. This was seconded by Mr. Anderson, and met with the universal approval of the members.

For the office of Vice-President, Mr. R. T. MacKeen moved, seconded by Mr. Chambers, that Mr. Colpitt retain his office as Vice-President. This motion also met with the approval of the members.

Mr. Chambers nominated Mr. Irving Smith, of Halifax, as Secretary-Treasurer.

Mr. Smith declining the nomination, Mr. Chambers nominated Mr. R. T. MacKeen, who was elected to the office.

Mr. R. T. MacKeen,
Secretary-Treasurer Maritime Electrical Association.

The following members were then elected to the Executive Committee : Messrs. Hial Brown, St. John, N. B.; J. Eddington, Moncton, N.B.; J. A. Waddell, Charlottetown, P.E.I.; S. G. Chambers, Truro, N.S.; W. Pickles, Irving Smith, J. A. Anderson, and F. A. Hamilton, Halifax.

Mr. Miller moved that a vote of thanks be tendered to Mr. J. H. Winfield, the retiring Secretary-Treasurer. This was seconded and carried unanimously.

Mr. Winfield expressed his gratitude to the members for their token of regard. In the course of his remarks he referred to the suggestion made by Mr. Bowman in regard to the difficulty experienced by the officers in fulfilling their respective duties, owing to their living at such a distance from the majority of the members. He thought that for the first few years the principal officers, at least, should be so located that they would be in touch with most of the members, thus increasing their opportunities for developing the Association.

It was then moved and carried that the selection of place and date of next meeting be left to the newly-elected Executive Committee.

Upon motion of Mr. Hamilton, seconded by Mr. Miller, the meeting adjourned until the afternoon.

AFTERNOON SESSION.

The afternoon session opened at 3 p.m., with the Vice-President in the chair. A few moments were devoted to completing the business of the morning. The President then invited Mr. P. R. Colpitt to read his paper on fire alarm telegraph systems, which was as follows:

THE EVOLUTION OF THE FIRE ALARM TELEGRAPH.

By P. R. Colpitt.

In submitting a paper on the above subject, I propose to briefly describe the system as it is to-day, and the various stages of improvement that led to its present stage of perfection.

Until 1850 (a period within the memory of some of the members of this Association) electric fire alarms were unknown. In the largest cities there was no means for arousing firemen and citizens except the primitive method of shouting and ringing bells or sounding steam whistles—which still prevails in most of our towns. In New York as early as 1845 the city was divided into districts, in each of which a watch tower was erected where a watchman was on duty at all hours. The districts were numbered, and when a watchman discovered a fire by seeing the smoke or flame, or a fire was reported to him, he would strike upon his bell the number of the district. This was heard by the watchman on the next tower and by him repeated, and in that way the alarm was gradually announced all over the city.

The first suggestion for the use of the telegraph for fire alarms was made by Dr. W. F. Channing, of Boston, directly after the earliest telegraph experiments of Prof. Morse in 1839. In 1845 Dr. Channing published an article in the "Boston Advertiser" describing a method for the application of the telegraph for giving alarms of fire. In 1851 he managed to interest the city council of Boston in his scheme to the extent that $10,000 was appropriated for an experiment. Dr. Channing's plan was to establish numerous box stations over the city connected by telegraph circuits with a central station from which signals received from boxes were sent out over other circuits to the bell towers—the signal was thus simultaneously struck on every fire-bell in the city by electric mechanism. At about this time Dr. Channing associated himself with Moses G. Farmer, who was a recognized expert electrical mechanic of that day, and Mr. Farmer worked out practically the machinery necessary to complete the inventions made either by Dr. Channing or by Channing and Farmer jointly. Mr. Farmer constructed the Boston system and had charge of it for several years. Messrs. Channing and Farmer took out many patents which were the foundation of the fire alarm system as it exists to-day.

In 1855 John M. Gamewell purchased the Channing and Farmer patents for the Southern States, and four years later acquired the patents for the rest of the country. This was the beginning of the well known Gamewell Fire Alarm Telegraph Company and of the several companies now manufacturing fire alarm and police signal apparatus. The Gamewell concern is probably the best known because of its greater age. All fire alarm telegraph systems, as far as the writer's knowledge goes, embody the fundamental principles of the early Channing patents, so that a description of one will serve for all as far as general principle goes. Any difference or improvement that one may have over the other is in arrangement of detail.

DESCRIPTION.

A fire alarm telegraph system consists of a central station provided with closed circuit batteries or other course of electrical energy, switch-board, automatic repeater and other instruments for regulating and controlling the system, wire circuits for connecting the central station with the street signal boxes, and alarm apparatus consisting of electro-mechanical bell checkers, electro-mechanical gong strikers, located in engine houses or residences of fire department officials, and visual indicators showing in plain figures the number of the signal box from which an alarm originates. The system is a closed circuit one, and any interruption of the circuit will release all the armatures of magnets, causing the bells to strike. To get any signal number, therefore, it is obviously only necessary to have mechanism to open and close the circuit a pre-determined number of times. This is accomplished in the signal boxes in the following manner:

A break wheel is provided with radial projections on its face to correspond with the number of signal required. Two German silver contact springs are so placed that they come in contact with the projections on the break wheel, thus opening and closing the circuit as the wheel revolves. In the first boxes this break wheel was operated by hand by turning a crank, one revolution of which would give the complete number. I am not in a position to tell how successful this style of box was, but am under the impression that the average man to-day under the excitement of having his property burning would turn that crank so fast that the armature would scarcely have time to release in a complete revolution. The modern boxes, however, are provided with clock work, the propelling power being a spring, so that simply releasing a dentin by pulling a hook is all that is necessary to set the clock work in motion.

A difficulty arose in the first boxes, in that there was nothing to prevent alarms from being pulled in from different boxes simultaneously, thus causing a mix up in signals given; this was first abated in the following manner: A small magnet was placed in each signal box, the armature of which when released operated to short circuit the break wheel, thus preventing the circuit from opening in the box. The above armature was further provided with a knife edge engaging a similar knife edge on the dentin, so that if the circuit was open when the box was pulled the armature would be forced against the short-circuiting contacts, and keeping it there while the box was in operation. On the other hand, should the circuit be closed when the box was pulled the opposite sides of the knife edge would engage, thereby forcing the armature against the magnet and keeping it there while the box was in operation. The weak point in this arrangment was that should a box be pulled just at the time the break wheel in any other box in its revolution engaged the contacts, interference would occur. This defect has been remedied in the more modern boxes so that should the armature of the non-interfering magnet be released at the time the door is opened for pulling in an alarm, or any time between opening the door and pulling the hook, the dentin cannot be engaged and the box remainsinoperative. This system, whilea great improvement over those previously mentioned, was not perfect, in that a person pulling a box and getting no response would probably wait a short time and try again; but if he neglected to close the outside door the box would still remain inoperative though the circuit might be clear.

The latest improved boxes have the succession non-interfering principle. In this box the mechanism is so constructed that when a box is pulled after another has been started it will retain its signal until after the first box has finished, and will then transmit its signal without any possibility of interference or confusion.

On account of the common use of heavy currents for power and electric lighting, it has become necessary to provide each signa box with a cut-out that in some boxes operates to cut the entire box out of circuit when the door is closed. This not only serves to protect the box, but also greatly reduces the resistance of the system, thereby saving battery power. This cut-out is also arranged so that the box can be tested electrically and mechanically without disturbing the circuit. Lightning arresters are fitted to all boxes, strikers and gongs as a protection against disruptive discharges. The boxes are also provided with trap locks, so that when the box is unlocked the key cannot be removed except by a release key, these keys being carried by officials only.

The importance of transmitting alarms with the least possible delay has led to the introduction of various schemes for saving time in pulling in a box. In some cases a small auxiliary boxwith a glass front containing the key is fastened to the door of the signal box ; in order to get the key the glass must be broken. Another method is to have the hook or trigger protrude through the outer door, the end of it being encased in a small box as previously described. In this arrangement no key is required, but simply break the glass and pull the hook. Another arrangement, and probably the most popular one, consists of a trigger in the form of a handle attached to the door of the box, which being moved a half turn winds up clock work attached to the inside of the door, and this in turn operates to pull the trigger in the inside box, at the same time ringing a gong, indicating that the box is operating. The last named arrangement is the most convenient, but is open to the objection that false alarms can be pulled in boxes located in out-of-the-way places without much fear of detection ; in fact, a box of this style has been removed from one of our principal streets to the police station for safekeeping ; nevertheless, this style of box is used exclusively in many cities and very little trouble is experienced with them.

Great improvements have been made in gongs and tower strikers, but time will not admit of a detailed description of them; but a very valuable feature has in recent years been added to the signalling system that is worthy of notice, viz., the visual indicator. This instrument not only strikes the number of the box, but in addition indicates it in plain figures, thus removing all doubt or occasion for difference of opinion as to what box was pulled.

The central station, a very important part of the system, has also been greatly improved in recent years. At the inception and for many succeeding years, the gravity battery held full sway as the source of electrical energy ; but since the introduction and common use of the dynamo and the perfecting of the secondary battery, the old reliable gravity battery has become to a large extent a back number, and wisely so, for it is at best a very expensive system and requires considerable attention, while with the secondary battery, though the first cost is greater, the saving is so great that there is no room for comparison in fact, the cost for charging batteries is so small that in many places it is furnished free by the local companies. In large cities current is used from the commercial circuits after being transformed to the required pressure.

REPEATER.

Another very important part of the central station is the automatic signal repeater. In a fire alarm system the circuits are run to all sections of the city, and if they were all connected together in series the combined grounds on them all in bad weather would make it very uncomfortable for the superintendent. The office of the repeater is, as its name indicates, to automatically repeat any signal coming in over one circuit, on all the other circuits in the system. This is a very fine-working instrument and probably deserves the praise bestowed on it by Sir William Thompson, now Lord Kelvin, at the Centennial Exposition, when he said it was the most ingenious and finest piece of telegraphic mechanism ever exhibited. It not only repeats the signal instantly, but in case a circuit breaks the repeater, after sounding one blow on the other circuits, throws the disabled one out of service, leaving the others intact. As soon as the broken circuit is repaired it is automatically taken into service again. In a large city where the circuits amount to more than ten in number, a manual central office is necessary. In such an office operators are constantly on duty to receive alarms from the box circuits and to send them out over the alarm circuits, also to watch and test the circuits by means of a far more complicated and expensive apparatus than is necessary to use in smaller localities. In a system embodying a manual central office, the instant that a street box is pulled the following notifications are simultaneously approving where the skilful operators are on watch for them. The box number is being sounded on a tapping or small gong, the same number is being recorded visibly by the multiple pen-register, and a cylinder, which is one of a series representing every circuit in the system, revolves and brings into view on its reverse side the numbers of the boxes on the circuit from which the alarm has come. Upon the completion of the first round of any of these signals the operator, by a single movement of a lever on the switchboard, connects the box circuits with the combination alarm circuits and instantly the box number is being tapped in the engine houses and recorded on the tape register direcly from the street box. The next operation is to set the dial transmitter to the number of the box required, which send out over the alarm circuits as many rounds of the box number as the rules may require. All alarms are, therefore, received simultaneously at the engine houses over two district circuits and registered and announced on two sets of instruments.

All of this is, of course, done within less time than it takes to read this description of the process, and usually before the alarm box stops running, after it has been pulled for an alarm, the signal has been received at the central office, has been sent out over two independent circuits, the firemen have responded, horses have been harnessed, and the apparatus on its way to the fire.

Other important parts of the equipment of a large central office are the pin register, line tester and annunciator board. The first of these automatically registers upon a paper roll the record of all the signals received into or transmitted from the office. The line tester automatically tests all the circuits and every twenty minutes reports any grounds or open circuits that may occur. The annunciator board is for the purpose of showing the numbers of the companies which have left their houses to attend alarms, and as fast as these companies are released from duty the operator restores the corresponding drop. Thus, at a glance, the operators can tell at all times what apparatus is available. The line construction of a fire alarm system should be of the best description. A line down or rendered inoperative by crosses or grounds might cost many thousands of dollars more than the first cost of the whole system. The writer is of the opinion that when fire alarm wires are on poles used for carrying other wires they should be on top of all others and as far as possible removed from them. This is by no means the universal custom, however, as many prefer to have them strung on the lower arms.

It is scarcely necessary to add that a fire alarm system requires constant care and attention the nature of the service and the grade of apparatus employed will suggest this. The agent will probably tell you confidentially that any fireman can keep it in order, likewise the dynamo agent and we have a few, though not enough, in our Association who will tell you that the particular generator that he is selling is absolutely self-oiling, self-regulating and self-righteous ; but it does not always follow that this is so, as some of us can testify to.

I have tried briefly in this paper to give the evolution of the fire alarm telegraph, and if in so doing I have succeeded in showing its importance in connection with any fire department regardless of size, I shall feel amply repaid for the time spent in writing it. Surely the recent disastrous fires in some of the fairest of Nova Scotia's towns are object lessons not to be put lightly aside.

DISCUSSION.

Mr. Hamilton, after expressing his pleasure at listening to so valuable and interesting a paper, questioned Mr. Colpitt regarding the use of storage batteries in operating the system, in lieu of primary batteries, also regarding the satisfactory results of charging storage batteries from alternating current circuits through the medium of the rotary transformer.

Mr. Colpitt, replying, stated that secondary batteries had almost superseded primary batteries in the larger cities, and that rotary transformers had been used successfully in charging same. He stated that it required but little energy to operate the fire alarm system, the current rarely exceeding one-tenth of an ampere at a potential, depending upon the length and number of circuits.

Mr. Bowman followed, and after congratulating Mr. Colpitt on the concise manner in which he had presented so interesting a subject, expressed the opinion that it would prove of great benefit to laymen in general if the paper could be distributed among them. It would have a tendency to make town authorities purchase reliable apparatus.

Mr. Chambers interrogated Mr. Colpitt more closely regarding the charging of accumulators from street mains, and concluded his remarks by moving that a vote of thanks be tendered Mr. Colpitt for his paper.

The President then introduced Mr. Hamilton, who presented the following paper entitled "Reminiscences."

REMINISCENCES.

By F. A. Hamilton, M.I.E.E., M. Can. Soc. C.E.

The telephone, like many other adaptations arising from discoveries of nature's secrets, is the outcome of evolution, but it is a plant which, when once matured soon burst into blossom and bore fruit. The marvellous instrument is in more general use than any other signalling apparatus under the sun, and yet it is the one concerning which those who use it the most are the very people who know the least about it. I, of course, allude to the general public.

It is simply astonishing to what an extent familiarity breeds indifference—particularly as regards some of the most prominent apparatus of applied science. The locomotive is an old tried and trusty contributor to our comforts and necessities, but how many of the thousands of people who are now being rapidly transported by this picturesque and snorting iron horse have the remotest idea as to its internal structure, or of the manner in which the steam power is applied?

Reverting to the telephone, it may not be an inappropriate observation to say that this most delicate and sensitive instrument is subject to more indignities than any other public servant one can call to mind at the present moment. The telegraph has doubtless occasionally conveyed sulphurous odors sufficiently strong to be a source of discomfort at remote distances, but the telephone leaves it far behind in respect to the conveying of "cursory" remarks and vituperative utterances. Never was an innocent victim more sinned against in this respect than the gentle telephone.

It would be interesting to study the nomenclature which has been introduced since the advent of the telephone, but this is neither the time nor the place for such enquiry; I would merely remark that "telephone beef" is a significant term as applied to meat ordered through the medium, instead of being selected by the housekeeper, and that "aught" instead of "naught" is a less justifiable innovation which by a strange perversity is in general use among telephone operators, especially in the United States.

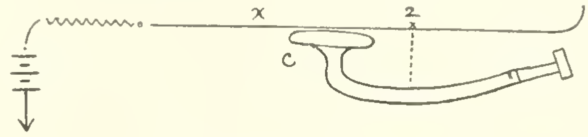
It was my habit at one time to regard the submarine telegraph cable as analagous to the steamship line, the land lines to the great trunk lines of railway, and the telephone lines as the interurban and suburban roads, but there is more than a doubt in my mind as to whether the analogy holds good at the present day, for the telephone is now carrying a considerable portion of the heavy traffic.

Speaking of the strong language to which the introduction of the telephone has given rise, or rather has been the means of radiating, one is naturally led to reflect that the age in which we live is an extremely exacting one. When we contrast the condition of things as they existed say, fifty, forty, thirty, nay twenty years ago, and even nearer to the present time as far as some places are concerned, when we compare the means of transportation, the methods of lighting, the facilities for communication, not only between cities and provinces, but between countries and continents, we cannot but recognize the centuries of difference between the crude methods of the past and those of to-day, and yet there are those who in their early days read by the flickering flame of the farthing rushlight or the tallow candle, and who travelled at a snail's pace in a springless cart, whose knowledge of the world outside of the prescribed limits of their own village was extremely meagre—owing to the sluggish means of inter-communication—who would have laughed to scorn the idea of electric telegraphs, and declared that the semaphore was sufficient for all such needs; who would have pronounced a man mad had he claimed to be able to speak viva voce along a wire, and derided as a fool the dreamer who ventured to predict that the ordinary horse-drawn carriage would be succeeded by such a conveyance as that described by the Celestial as "no pushee, no pullee, all samee hellee," which now rushes clanging through our streets.

But let there be an instant's delay in connection with the telephone, or the street car, or an interruption in telegraphic communication, or even a flicker in the electric light, let such things happen, why then the air becomes of an unnatural tint and perturbation reigns supreme. Verily, this an exacting age. I am not complaining, but simply stating what I believe to be a fact.

I am not sufficiently conversant with the details of the telephone business as it exists to-day to discuss the manifold appliances connected therewith, but with regard to some of the multifarious uses to which this instrument can be applied, I can speak from experience. As an aid in the detection and localization of faults in subterranean and sub-aqueous electric cables, and in electric circuits generally, the telephone can be used with great advantage, as the following instances will sufficiently illustrate:

Let A ——x——2—— B be an insulated conductor in which a leak exists at 2, the approximate position of which has, in the case of a subterranean cable, for example, been determined. By applying an intermittent current to the line and using a coil of insulated wire in circuit with the telephone, the exact position of the fault can be found without cutting the cable. With the end free at station B, and an intermittent current applied at A, the length x + 2 becomes the primary circuit, and the coil c with the telephone the secondary circuit. By moving the coil along the line and applying the ear to the telephone the position of the fault can be determined with the greatest accuracy, for immediately on passing 2 the inductive effects will be reduced and the vibrations of the diaphragm of the telephone correspondingly enfeebled.

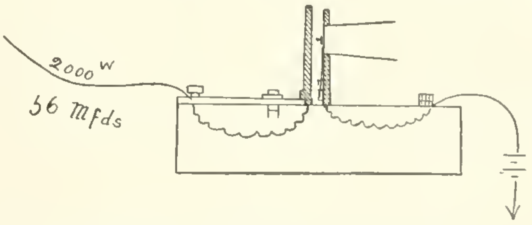


In repairing the street cables here in Halifax some years ago for the Direct United States Cable Co., the application of this method enabled me to save no inconsiderable expense, the labor in opening up the trench in which the four cables were laid being in consequence but a small item.

I have also found the telephone useful in detecting the exact moment when a change occurs at the "fault" consequent on the reversal of the battery current. According to the amount of conductor exposed at the break, or leak, will depend the length of time between the application of the current and the evolution of hydrogen gas at the fault, after the positive pole of the battery has had the effect of depositing chloride of copper on the exposed surface of the conductor. The telephone, being connected through a condenser on the line end of the Wheatstone bridge, will enable the operator to immediately detect the moment when the change of condition takes place.

Another very interesting and extremely useful application of the telephone in submarine cable repairs, after a splice has been made, is to ascertain if the line is working. It has sometimes happened that in making what is known as a "final splice" to a cable at sea—that is to say, joining up the two ends which connect with the shore on either hand—that a rupture has occurred, unknown to those on board the vessel. By means of a prearranged system of signals from each station, and the application of the telephoue in the manner already described, the rupture of the cable would be known on board by the absence of the signal from the station cut-off.

It would be interesting to know what is the greatest length of submarine or subterranean cable through which telephone speech has been exchanged. As long ago as the year 1878, when the construction of various forms of microphones was one of my hobbies, I tried an experiment, the mention of which may perhaps be of interest. It was during the repair of a cable between Sydney, C.B., and the Island of St. Pierre-Miquelon. We were about 20 miles from Sydney. I requested St. Pierre to put on a telephone. The reply was, "It is no use; we tried to speak to Placentia, but did not succeed." The length of cable between St. Pierre and Placentia being 112 nautical miles, and that through which we were signalling 188 miles, including 20 miles on board the ship, rendered the conditions anything but promising. However, I persisted, and St. Pierre joined up his telephone. The transmitter—or, as I then called it, the microphone—I had in circuit was fearfully and wonderfully made. The base was a cigar box, on which were mounted a piece of battery carbon, a frame carrying a parchment diaphragm, against which a spring with a pencil point—graphite—lightly pressed, and a mouthpiece. The circuit was completed through the graphite point, the stick of carbon and the cable. The resistance of the line was about 2,000 ohms, and its electrostatic capacity about 56 microfarads. Into the mouthpiece of the microphone I sang a snatch from a light opera then popular, scarcely daring to hope that the sounds would be heard at St. Pierre, but on joining up to the Morse instrument and enquiring if they had heard anything,? the reply was "Yes, heard someone singing."



What tune? We asked.

"Fille de Madame Angot" was the correct answer.

An encore being called for, several other tunes were warbled into the monster. But we did not succeed in imparting audible articulations.

There is another application of the telephone to which I may here allude. In April, 1885, whilst crossing the Atlantic after a heavy gale, we came upon a dismasted vessel, the barque "Hudson." This vessel, bound from Java to London, 131 days out, was a pitiful, but withal picturesque object. Jib-boom, foretop mast, main-mast, all gone, the foreyard and fore-topsail yards hanging a-peak, bulwarks washed away, and a labyrinth of rigging snaking alongside. On the stump of her mizzenmast was lashed a stun-sail boom, rigged for a signal staff, and on it floated jauntily the gay bunting "K R L" of the Commercial Code, signifying "will you take me in tow?"

We did take her in tow, and along one of the hawsers I had a length of insulated conductor secured, by means of which telephonic communication was established between the two vessels.

Whether towing vessels are now provided with such means I know not, but there is no reason why frantic gestures, fearful yellings and demoniacal howls should be the sole means of conveying "intelligence" between the towing vessel and the towed.

I trust that you will excuse me for indulging in these reminiscences; such recollections are apt to crowd upon one in reviewing events in connection with such operations as those to which allusion has been made. I began my remarks with the intention of eulogising the telephone, and it may not be too much for me to say that I have made out a fairly good case in favor of this much used, much abused and withal unique application of scientific discovery.

There is one point of interest to be mentioned, but the discussion of it does not come within the scope of this paper. I allude to the manner in which telephone wires are run within buildings. When one considers the multiplicity of elaborate rules issued from various sources relating to the installation of electric light and power circuits, one marvels at the absence of any adequate provision against the ingress of foreign currents into a building via the telephone wires. I could point to an instance in this city of a narrow escape from a serious fire, resulting from an outside contact between the telephone wire and a conductor carrying a heavy current. The fact is, all wiring should be run in conduits wherever practicable. Of course it would be impolitic to condemn all the old wiring, but all new buildings should be provided with conduits. I beg to thank you for your kind and patient attention.

DISCUSSION.

Mr. Anderson opened the discussion by commenting upon the valuable suggestions embodied in the paper, and in referring to the careless method usually adopted of running telephone wires, expressed the opinion that more stringent rules should be adopted by the National Board of Fire Underwriters in regard to the installation of telephones, etc.

Mr. Chambers cited an instance of serious damage resulting from fire caused by the telephone wire coming in contact with live circuits outside of building. Had the same care been exercised in installing the telephone wires that is taken when installing electric light wires, the trouble would not have occurred.

A vote of thanks was tendered Mr. Hamilton for his valuable paper.

The President then introduced Mr. J. A. Anderson, who read a paper on iron-armored conduit installations.

THE IRON ARMOURED CONDUIT INSTALLATION AT ST. MARY'S CATHEDRAL, HALIFAX.

By J. A. Anderson.

The first iron or steel conduit system in Halifax was installed some 16 months ago by Messrs. John Starr, Son & Co., in St. Mary's Cathedral, under plans and specifications drawn up by Mr. F. A. Hamilton. The conduit used is uninsulated mild drawn steel, made by the Boston Electroduct Co., and is coated with a special compound which prevents oxidation or rusting of the surface. The makers claim that coated samples of this conduit have been immersed in acids and alkalies and buried in the ground for over a year, and has also been soaked in sea water and subjected to steam and oil, and in every case the coating remained intact and the lustre as bright as when first applied.

The wire used is double rubber covered and double braided. The several circuits are controlled from a slate switchboard which is located in the vestry of the church, in a large cabinet handsomely finished and having plate glass doors, giving full view to the whole interior; on this board is mounted one 50 ampere and eight 35 ampere switches of the knife pattern, also one pilot lamp and bracket and the Tramway Co's watt meter. The main and branch circuits are separately protected with fuses of the Link type connected to brass terminal screws which pass through the board and having brass lugs attached thereto, the wiring all being done on the back of the board, the wires being "sweated" into the lugs from where the pipes pass through the floor into the basement of the church, passing through the necessary junction boxes, some of which are located at the base of the large columns, on which are mounted the different fixtures in the body of the church. Smaller pipes are used from the junction boxes to the outlet and placed in the recesses of the column, and are marbleized to match the church finish. The piping was all completed first, then the wires were drawn in by means of a No. 10 galvanized wire.

The circuits are laid out so that there will be no unnecessary waste of light, and at the same time that sufficient light may be had for the different devotions, and are divided as follows: (1) two centre columns and east porch; (2) east altar and pulpit; (3) west altar and sanctuary; (4) west columns; (5) east columns; (6) organ, under gallery and porch. The brackets and fixtures were made from special drawings prepared by the Rev. Dr. Murphy; they are combination gas and electric and are finished in rich gilt. The advantage of having lights properly switched has been exemplified in this instance in effecting a saving in cost with the use of electricity with a 50% greater number of lights than there was originally with gas.

DISCUSSION.

Mr. Hamilton opened the discussion. He questioned the apparently needless statement found in the rules of the Fire Underwriters Association, i.e., that wires used in iron-armored conduit work should be provided with a double braided cotton covering. He considered that the one essential of wire used in this method was that it should be flexible. The double braiding was not necessary as far as insulating qualities were concerned, and certainly did not add to the flexibility of the wire.

Mr. Huntress, while partly endorsing the views of Mr. Hamilton, expressed the opinion that the better insulated the wire was, without reducing its flexibility materially, the less danger there would be from careless wiremen, who neglected to form a bell mouth at the ends of the conduit, which reduces the danger of abrasion to a minimum.

Mr. Hamilton supported his previous contention by stating that the wire would be made needlessly large by adding the double braiding, and thus require larger sizes of conduit. He also raised the question why flexible cable was not used to a larger extent than it is for this class of work.

Mr. Siebert stated that the reason for such a rule was to protect the customer from poor work.

Mr. Bowman said the rules were a combination of all interests, being compiled by representatives of all those concerned.

Mr. Anderson cited some cases where weatherproof wire had been used for circuits, and a short piece of rubber-covered wire soldered on where the wires emerged from the conduit, in this way taking advantage of the customer.

Mr. MacKeen referred to a case which occurred in Boston in connection with pulling in wires through conduit. Considerable difficulty had occurred in pulling the wire through a long conduit owing to the crushed condition of the pipe, caused while forming offsets.

The passage had been so reduced that considerable force was necessary to pull the wire through, so much, in fact, that the wire stretched to such an extent that the diameter was materially reduced, thus reducing its carrying capacity, and consequently it had to be withdrawn

Mr. Siebert expressed the opinion that more stringent rules should be adopted by those qualified to compile them, and steps taken to enforce them, thus overcoming the rascality of some wiremen.

Mr. Anderson thought that if wiremen were required to qualify before being allowed to practice the profession, less trouble would result from careless workmen.

Mr. Archibald, while partially endorsing the views of Mr. Siebert, thought that a limit was necessary. If too stringent rules were adopted and enforced, there would be a great temptation on the part of wiremen to violate them. In concluding his remarks, he moved a vote of thanks to Mr. Anderson for his valuable paper.

The following paper on "Steam Engineering," by Mr. P. A. Freeman, was read by the Secretary :

STEAM ENGINEERING.

By P. A. Freeman.

The subject of this paper, Steam Engineering, covers such a broad field that I finally decided to confine my paper to certain limits, avoiding all intricate formula and deductions, although both are necessary for the competent engineer.

At times it is somewhat difficult for an engineer to decide upon the type of boiler to use, and in every case the choice should depend upon the nature of the work demanded, whether it is better to use water tube, externally or internally fired, etc. Many plants are able to use with good economy a return tubular boiler, and the selection of a water tube boiler would be of no advantage in comparison with the increased first cost.

For railroad work and for any kind where the demand for steam is liable to increase rapidly during certain hours of the day, the water tube boiler is by far the best. With a first-class water tube boiler a fireman can carry for a certain length of time from 50% to 100% above the rating of the boiler.

In our plant at the tramway station we have four 250 h.p. Babcock & Wilcox boilers, and it has been a common occurrence during the winter months for us to carry 50 to 75% above the rating of the boilers for several hours. For such service a quick steaming boiler is necessary, and is only to be found in the water tube boiler.

In these days of keen competition it is absolutely necessary to take every precaution for reducing operating expenses, of which the coal pile represents a large percentage. The best of boilers will not take care of themselves and will generate steam according to the manner in which they are treated. Shovelling coal into the furnace and keeping a sufficient supply of water in a boiler do not constitute the entire duties of a fireman. He must shovel coal and feed water to the boiler intelligently and study the peculiarities of the steaming properties of his boilers and coal. I might add that no two boilers of the same make with exactly the same handling will give the same results.

The proper maintenance of boilers demands that they should be shut down and examined inside and outside thoroughly at least every nine weeks. The boiler should be thoroughly blown out and cleaned even if solvents are to be used for the prevention of scale. In our plant we use the following method for preventing scale and for cleaning boilers : The feed water is supplied to the boiler from a tank capable of holding 3500 cubic feet ; suspended in this tank is a bag containing about 50 lbs. of lime, which is renewed twice each month. We find that this method of treating our feed water has a considerable tendency to prevent scale formation. When the boiler is taken off the line for cleaning and general overhauling we pump it full of water, in which about 10 lbs. of sal soda have been dissolved while it is still under full pressure. It is then allowed to remain 48 hours, when by this time the steam pressure has fallen. The blow-off is opened and the boiler emptied. It would seem at first that this would be sufficient to thoroughly cleanse the boiler, but it is not so. If the feed valve is slightly opened and the water allowed to flow slowly through the boiler it will then be thoroughly cleaned, as this slow filtration through the boiler seems to bring with it all the dirt, scale, etc., which was not carried away by blowing down. Also, particular care should be taken that the feed valves of the other boilers are closed during the time we are filling the boiler with the sal soda solution, otherwise the brass fittings, etc., will be seriously affected.

Safety valves are the most delicate part of a boiler and demand constant care and watching if we wish them to work fairly accurately. My experience with spring safety valves has led me to adopt the rule that all our safety valves shall be lifted from off their seats once every 24 hours. If this is not done I find that a so-called skin forms on spring and seat, and if the valve is not lifted oftener than once a week it will take considerable more pressure to lift it than for which it was originally set. Another very serious trouble with safety valves which often occurs is the loosening of the check nut, and if this is not attended to immediately upon the indication of such trouble the steam pressure will drop and all steam escape into atmosphere, shutting down the plant. Although it at first appears difficult to the engineer or fireman to tighten the nut and set the valve properly, nevertheless if he understands his type of valve thoroughly he can accomplish it with his monkey wrench, hammer and chisel in very short space of time with perfect safety to himself and plant. If the valve should commence to blow off and steam pressure drop more than 5 lbs., or if the steam pressure should at any time drop more than proper on account of the safety valve blowing off, the engineer or fireman should at once assume that the valve is out of order and must be attended to immediately. If check nut is loose it can be remedied by turning the valve spindle to the right until the steam stops escaping, then the cap may be removed and the check nut tightened without further difficulty. The boiler pressure should be increased to the same point at which the valve blew off, and beyond, in order to make certain that the valve will blow off at the proper pressure. This point can be easily obtained by slightly turning the valve in the proper direction.

The above method of handling the safety valve is that commonly used in ordinary practice, but for close regulation the cushion seat should also be raised or lowered according to the range within which it is desired to have the safety valve act. Under no conditions should the safety valve spindle, or any of its parts be struck or hammered in order to make it close, as this is a very dangerous practice and is liable to cause more or less serious explosions. This latter precaution of mine may seem to be hardly necessary, yet in my own experience I have seen an engineer strike down on the spindle with a piece of wood 6 x 6 with the idea of causing the valve to close. Although at this time of which I speak no serious results occurred, it might cause great danger the very next time it was tried.

Water tube boilers have the following very essential qualifications not met with in other types of boilers :

They have the property of steaming quickly on account of the rapid circulation and good combustion. The liability of dangerous explosions is reduced to a minimum on account of the tubes, which are the weakest point of the boilers, splitting and thus allowing extra vent for the steam. On the other hand, these tubes are easily and quickly replaced if burned out or injured in any manner. For fear some of you might obtain the impression that the tubes are a weak point in the ordinary running, I might state the case of one set of boilers which we have in our station. These boilers have been in constant use for seven years, and the only repair necessary beyond that of replacing grates and brick was the inserting of one tube which had been injured through carelessness in allowing water to flow over the outside of the tube from a leak in the feed water piping. This caused a blister on the tube, and although it did not weaken it seriously, it was considered advisable to replace it before any damage should occur.

My experience has led me to believe that boiler explosions are caused by careless and unintelligent attention to the supply of water, and not at all times through any inherent defects in the boiler. The gauge cocks should be tried regularly in order to detect any false indications of water in the glass. False indication of water is not by any means an uncommon occurrence. The sudden breaking of a gauge glass causes the valves of the column to be closed, and on replacing the glass the bottom valve is opened and the upper one forgotten. The glass under such conditions will show false water, as the water will remain in the glass until the boiler is emptied, held in position by the vacuum in the top of the glass. This very case has occurred in our own plant, but any dangerous results were averted by prompt action.

In connection with this I recall an answer given by my chief in the west end power house to the Board of Examiners. He was asked what he would do if on entering a boiler room he discovered

(Continued on Page 86.)

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Acetylene Gas.

THE Boston Manufacturers' Mutual Fire Insurance Company, in response to many inquiries from its members, has had the subject of acetylene lighting, including its advantages and dangers, and the proper appliances to use for the purpose, carefully examined, and, as a result of its examination, advises its members not to try the experiment of using it at present, until better methods and appliances are available than any yet put on the market.

Inspection of Steam Boilers.

THE government of British Columbia has passed a law providing for the compulsory inspection of steam boilers before being put in operation, and periodically while in use. It is learned that the government of Nova Scotia will, at the next session, introduce a bill along the same lines. The day is apparently near at hand when all steam plants in the Dominion will not only be placed under the supervision of government inspectors, but when additional protection will be afforded the public by making it compulsory upon engineers to show that they are properly qualified to assume charge of a steam plant. Surely Ontario, the banner province of the Dominion, will now follow the example set by British Columbia, and thus assist in raising the standard of steam engineering in Canada. Unfortunately, one or two attempts in the past to secure a law for the licensing of engineers have not met with success.

The Maritime Electrical Association.

IN the building up of an association, much depends upon the character of the foundation established in the early days of its existence. Conscious of this fact, the promoters of the Maritime Electrical Association, formed one year ago, have labored earnestly to reach that point from which there would be likely to grow a useful and progressive association. How far they have succeeded can be judged in a measure from the report of the second convention, which appears elsewhere in this number. Notwithstanding drawbacks, which need not here be enumerated, the standard reached within the short space of twelve months since organization should be encouraging to the executive officers and those members who have contributed to its support. If the present interest can be maintained, there need be little fear of the future welfare of the association. Its membership is now over sixty, and it is believed that this can be considerably increased, particularly by interesting a greater number of cable and telegraph men. The several excellent papers and the discussions thereupon, which formed one of the most important features of the recent convention, is a most hopeful indication of a successful association. It is encouraging to observe the practical character of the papers and their wide scope, being designed to interest the lighting, railway, telegraph, telephone and fire alarm departments of the electrical industry. To the author of each paper equal credit is due, but the subject of electric meters, taken up by Mr. Mackeen, is one which has a particularly wide interest. While much has been written regarding the meter, we seldom find the subject treated in such a practical and simple manner as in this paper. As a means of inducing discussion upon questions brought out, it would be an advantage to have copies of the papers placed in the hands of the members prior to the day of the convention. They would then be able to read them carefully and discuss them more intelligently at the meeting. This as a suggestion to the officers-elect, who will be equally interested with their predecessors in strengthening the association.

The Electric Light Bill and the Canadian Electrical Association

THE passing of the Conmee Bill should be, and doubtless is, the subject of congratulation and thankfulness on the part of private electric lighting companies in Ontario. It gives a fair measure of security to their investments, which could at any time previously have been wiped out by the decision of the municipality to engage in electric lighting. The clause which provides that the price to be charged by the company for light shall be determined by arbitration in the event of dispute, is of distinct advantage to the municipality, and must tend to lessen the desire for municipal control. Notwithstanding the manifest wish and attempt of the promoters to make the provisions of the Bill fair both to the companies and the municipalities, its course through the Legislature was attended by many uncertainties and difficulties, of which those not intimately associated with the movement can have little appreciation. Well known members of the House who were depended on to take charge of the measure, after expressing their willingness to do so, afterwards declined, thereby causing delay and anxiety. Finally, however, the task was accepted by Mr. Conmee, and the result showed that it could not have fallen to better hands. The strongest possible opposition was offered to the measure by certain newspapers who saw an opportunity to make a bid for public favor, and of following the example of the Irishman of whom the story is told that he always made a point of voting with the majority. The statements of these papers were rightly discounted by the members of good judgment in the House, to whom it must have been apparent that the time had arrived when some consideration should be given, not only to the rights of the masses of the people, but of those who had freely invested their capital for the development of an important industry, from which large convenience and benefit had accrued to the public. The policy of the companies should now be "What we have we'll hold." The rights secured by the Conmee Bill must be carefully guarded. Assaults may and probably will be made on the new legislation at future sessions. Steps should therefore be taken whereby an organized effort can at any time be made to resist the passing of amendments calculated to weaken or destroy the protection afforded by the Bill. The usefulness and value of the Canadian Electrical Association have been clearly demonstrated in connection with this movement, which has ended so satisfactorily, and which was conducted through the medium of that organization. Without such an organization the work could not have been so expeditiously and effectively done, and the result might not have been so satisfactory. Credit is also due to the following gentlemen composing the Legislation Committee, who, in conjunction with the President and Secretary of the Association, and the solicitors, Messrs. Donald Guthrie, Q.C., and W. D. McPherson, successfully conducted the campaign: John Yule, manager of the Guelph Light & Power Company, Guelph, chairman; W. H. Comstock, president of the Gas & Electric Light Company, Brockville; B. F. Reesor, manager of the Light, Heat & Power Company, Lindsay; J. J. Wright, manager of the Toronto Electric Light Company, Toronto; C. B. Hunt, manager of the London Electric Co., London; A. L. Breithaupt, manager of the Berlin Electric Light & Street Railway Company, Berlin; R. O. McCulloch, of the Goldie & McCulloch Company, Galt; David Speirs, president of the Electric Light Company, Galt; John Farley, Q.C., president of the Gas & Electric Light Company, St. Thomas; S. J. Parker, president of the Electric Light & Gas Company, Owen Sound; Thomas Sadler, president of the Light, Heat & Power Company, Lindsay. Many of the companies by their co-operation gave valuable assistance to the committee. These companies, and all others, should now become members of the Canadian Electrical Association, and give what support they can to an organization that has already done much and may in the future do more for the development and welfare of the electrical industry of Canada. We hope to see at the annual convention of the Association at Hamilton in June a larger representation than ever before from the electric lighting companies.

THE CANADIAN ELECTRICAL ASSOCIATION.

At a meeting held recently of the Committee appointed to make the local arrangements for the approaching annual convention of the Canadian Electrical Association at Hamilton, a draft programme was considered and adopted. The dates selected for the convention, subject to the approval of the Executive, are the 28th, 29th, and 30th of June. The business sessions, as well as the annual banquet, will probably be held in the new Royal Hotel. A sufficient number of papers on a variety of subjects of interest to those engaged in the various departments of electrical work, have been promised, and are in course of preparation. Among the features of entertainment will probably be a trip to the Beach over the Hamilton Radial Railway and an evening excursion on the lake, a trip to Grimsby Park over the Hamilton, Grimsby & Beamsville Electric Railway, and a visit of inspection to the stations of the Cataract Power Company at St. Catharines and Hamilton. The Hamilton Street Railway Company have very kindly offered free transportation to members of the Association during the convention. Everything points to a successful and enjoyable meeting.

MARITIME ELECTRICAL ASSOCIATION.

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no indication water in his boiler. He said he would make sure his water was shut off, close all drafts and open his fire-box door. On being asked what he would do next, he replied that he would leave the building and watch it from a safe distance.

Pumps are usually given the least care, worked the hardest of the equipment, and at the same time play the most important part in a station. They should be given the same careful attention as the steam engine. We make it a practice to completely overhaul our pumps once a week in order to detect any faults that may exist, or are liable to occur. Special care should be paid to the water plunger and valves; valves should be used which are made to withstand the temperature of the water which passes through them. Disregard to this may cause serious trouble.

All modern plants should be equipped with heaters and condensers, either jet or surface. In our station the heaters raise the temperature of the feed water during the winter months to 120° and during the summer months to 140 . This difference in temperature is accounted for by the difference in temperature of the city water at the above seasons. We use a jet condenser, which gives an increased economy of 20 .. Surface condensers should not be used if possible on account of the deteriorating effect of the oil upon the tubes of the boilers,and if the water is not to be used again in the boilers, then there is no gain, but a loss, in installing surface condensers on account of increased first cost and increased cost in running. Heaters and condensers demand the same careful attention as pumps.

The selection of an engine demands the same careful consideration as boilers, whether high or low pressure, single or compound, high or low speed, steam jacketed, etc. For heavy and variable loads the compound engine is generally accepted. Large low speed compound engines with wide expansion are generally accepted as more efficient than the single cylinder engine. This is clearly shown by the result of test on the compound engine in the U. S. gunboat "Boche." When this engine was run as a single engine it used 24 lbs. of steam per 1 h.p., and when run as a compound engine with the same load, steam pressure, and under the same general conditions, it only used 20 lbs. of steam per h.p., thus demonstrating that the compound engine was 20% more efficient than the single engine. Especially are compound engines more efficient with high steam pressure.

Engines for street railroad work, and other work imposing sudden changes of load and unusually heavy strains, should be built with heavy forged cranks, and wheels of about double the usual weight, and with all the parts in such proportions as will give perfect work under the most trying conditions. Governors for this work must be especially good and must respond to sudden changes of load and continue to regulate closely under all circumstances. The variable cut-off on low pressure cylinders is also a strong point in such engines for this work, as it ensures quick work, quick regulation and high economy. Under variable loads the regulation of our Robb engine is within 2%, giving the greatest satisfaction, and up to the present time two of this type of engine have been in constant use on our railroad load since February, 1896, on an average of 18 hours per day, from no load to full load and at times 50% overload. We set our values for our average load, as the maximum pull does not last longer than 10 seconds duration.

An engine should be indicated every three months, on account of the wear and tear of the parts and variation in the valve rod. Our engines were first set by hand and then by the use of the indicator, and a saving of 19% was shown. On taking charge of our present plant the boilers were carrying nearly their capacity. By indicating the engines and setting valves properly we were able to increase our engine load 50% and only increased our boiler load 10%.

All this simply goes to show that the indicator should be used freely and intelligently in order to effect the greatest economy.

The profitable use of steam jackets is a much discussed question, and many engineers disagree. My experience with 9-100 h.p. steam jacketed engine has led me to doubt the advisability of using the steam jacket. In my opinion the extra cost of maintaining the extra steam piping and traps, and the liability of damage to the cylinders, more than counterbalances the saving obtained by steam jackets. If an engine has cooled down the greatest care must be taken in re-heating the cylinder through the use of the steam jacket, or else a cracked cylinder will result on account of the unequal expansion. Such an accident has occurred under my own observation, and it has not made me very enthusiastic over steam jackets.

If I did not consider that I have already occupied my share of your time I would like to take up the subject of engineering in a more technical manner, giving figures to back up my statements; also the proper handling of coal, draft, etc., but the latter subjects demand a paper on themselves and can hardly be treated sufficiently in a paper of this kind.

I wish to thank the members for their attention, and if the paper has suggested any questions which might be asked, I shall be only too glad to try to answer them.

The conclusion of the reading of the paper was greeted with applause, the subject proving an exceedingly interesting one.

DISCUSSION.

Mr. MacKeen, in opening the discussion, referred to the use of lime as a solvent in neutralizing the effect of acids present in the city water, also stating that some information regarding the different solvents used for this purpose might be of general interest.

The President, Mr. Bowman, referring to the use of a tank, asked Mr. Freeman if the tank was of sufficient size to permit matter in suspension in the water to settle. He also referred to the unreliability of gauge glasses, expressing the opinion that gauge or try cocks were more reliable and satisfactory. He recommended the placing of two sets on each boiler, one set being used to check the other.

Mr. Chambers requested information regarding low and high water alarms. This was furnished by Mr. Huntress and Mr. Freeman, who referred to systems used at the West End Street Railway, Boston.

Mr. Hamilton spoke of the steam jacket. The principal objections to its use, he said, were not generally known.

Mr. Freeman supplemented his paper by a few remarks regarding the different forces of draft used with different coals, his opinion being that different coals required different drafts, dependent to a large extent upon the methods of firing, conditions of weather, and direction of wind. In concluding his remarks, he said that he had not devoted the time to the preparation of his subject that it deserved.

A hearty vote of thanks was tendered Mr. Freeman for his interesting paper.

The President then introduced Mr. MacKeen, who submitted the following paper on "Electric Meters":

ELRCTRIC METERS.

By R. T. MacKeen.

In selecting the electric meter as the subject matter of my paper, it was with a view to treat upon a subject that is probably of considerable interest to many of those present, and one which usually furnishes material for a large amount of discussion upon occasions of this nature, and with this fact in view I respectfully submit it. The history of the electric meter from its inception would certainly constitute very interesting reading, and a collection of the various types used in "ye olden days," as it were, would occupy a very prominent place in an electrical museum, even at this early date.

Many of us, no doubt, are familiar with the Edison chemical meter, the first successful apparatus, I believe, used for metering current supplied to customers. The principles upon which it is constructed constituted it an exceedingly accurate piece of apparatus. The trouble involved in determining its reading, however, has caused it to give way to the more easily handled Watt hour meter. Another disadvantage of the chemical meter which appeared prominently with the adoption of alternating current machinery, is that it registers upon direct currents only. In order to overcome this difficulty the ampere hour meter was devised, metering, as its name implies, the current only, giving a final result practically independent of the variation in voltage. An improvement in this regard, however, was the adoption of the Watt hour meter, which measures the total energy in watts, thus combining the relative instantaneous value of both current and E.M.F. As the Watt hour meter is now used almost exclusively, my remarks will refer particularly to it.

The majority of our electric light and power companies in the maritime provinces are at present selling power under what is termed the flat rate system, i.e., a fixed charge per light per year, a method which will surely be superseded by the more correct method of measuring the power supplied each individual customer and charging so much per kilowatt. The advantages to the company of a meter system over the flat rate system are manifold. I feel, however, that it would be impossible to do justice to the subject in the short time at my disposal. In passing I might state, however, one result of the adoption of a meter system which appears very prominent, i. e., the increased capacity of a station due to a system of selling current by meters, or in other words, customers demand less capacity at the station to supply the average load in proportion to their maximum load.

The fact that cost of power to a consumer is based upon the actual consumption as recorded by the meter causes the customer to be less extravagant with light particularly than when using it under the flat rate system. The result is that the company can possibly carry 20% more load with the same machines under the meter system than when operating under the flat rate system. The gross receipts may possibly be less at first if the meter system is adopted, but the net revenue will bear a higher ratio to the operating expenses, the coal pile being materially reduced. It is therefore possible that there are some present who are considering the adoption of the meter system, as well as some who are already familiar with it, to whom a few remarks regarding the selection, testing, installation and inspection of meters may be of interest.

The adoption of any one make of meter is necessarily based upon one's experience with it. In lieu of this, however, I might say that there is little chance for mistake in obtaining meters from any of the well known electrical supply houses, as manufacturers are bound as a result of competition, to a certain extent, to place a good article upon the market. The advantages, however, that any one meter may possess over another can only be determined by actual experience with it, and for the preliminary steps in this direction we must have recourse to the testing department.

Every station, whether large or small, should be provided with apparatus for testing meters. The entire revenue depends upon them and they should be treated accordingly. The apparatus necessary for testing is not extensive, nor does it form an item of much expense. In direct current stations, the necessary instruments are usually at hand, namely, an accurate ammeter and voltmeter; a portable direct reading wattmeter, however, is necessary for alternating currents. A reliable stop watch is also necessary to complete the outfit. A bank of lamps, or a water rheostat for testing power meters, forms a load which can be varied easily over a wide range. The connections for testing are as follows: The ammeter or series coil of the portable wattmeter is placed in series with the meter under test, care being taken in case of the portable wattmeter to insert it on the service side of the meter. The v. m. or shunt coil of the portable wattmeter is then connected in multiple with the shunt coil of the meter. The load is then adjusted to the capacity of the meter under test, and the accuracy of the meter can be calculated by noting the load and seconds for any definite number of revolutions, as follows: $\frac{3600 \text{ x constant x rev.}}{\text{seconds}} = \text{watts}$. The percentage of error either way is determined by the difference between the true watts as shown by the instrument and the value registered by the meter. Another method is to put a known load upon the meter and allow it to run for an hour or so, the error being deduced from the difference between the known load and that shown by the meter; this method, however, involves time and necessitates great care in reading the dial, and is therefore objectionable.

Meters should be tested on $\frac{1}{10}$ ½, full and 10% over load, the results being tabulated for future reference. Any error found upon testing can usually be remedied by moving the magnets toward the centre of the disc if meter is slow, or vice versa if fast, or in the case of some alternating current meters the drum or armature can be raised or lowered to accomplish the same result. A meter upon which testing and after adjusting does not record accurately to within 2% either way, both on full load and ½ load, should not be placed upon the line. It is rare, however, that new meters exhibit such a record after adjusting. Particular attention should be paid to the light load accuracy, as this usually forms the greater part of its load in actual service, and any inaccuracy on it affects the revenue on account of its longer duration more directly than the same inaccuracy on a variable load.

The meter begins its career upon being installed, and for satisfactory results depends to a large extent upon the care exercised in this regard. As a general rule, meters are placed just where the wireman elects to leave his meter loops, irrespective of the delicate nature of the instrument as well as the convenience of the meter reader and inspector. Vibration is a deadly enemy to the life of a lighting meter, having not only a tendency to render the meter fast, but by the reciprocating movement of the armature, scratches and ultimately chips the jewel. It, of course, requires time to effect the damage, but the meter is rendered inaccurate long before the jewel becomes useless. In connection with this, a good method of detecting vibration is to place a pencil between the teeth and touch the point to the wall, the slightest vibration being easily detected. It would be well if all the meters were installed as near the ground floor as possible. Any vibration would then be reduced to a minimum and the meter would also be subjected to a less variable temperature than if placed near the top of a building, the extreme of both heat and cold impairing its accuracy to a certain extent.

In connection with alternating current meters, some of those containing iron in their fields should not be placed upon inductive loads, such as motors or arc lamps having a low power factor, the tendency being to run slow. A method of overcoming this difficulty is to install two meters in series with each other, one being calibrated for a load of this nature or affected by it, the other being an ordinary meter. The difference in their readings at the end of the month will show the amount to be added to compensate for the error caused by the inductive load. Care should be taken in the case of meters installed on motor circuits that they are placed upon the service side of the switch, otherwise the field discharge of the motor is liable to injure the fine shunt windings by the alternate expansion and contraction of the wire, which chafes the insulation and ultimately ends in a short-circuit.

A mistake is often made in installing too large a meter for the number of lights without considering its light load accuracy. The meter of to-day will stand an overload of 20% for a brief period and will usually be found to register quite correctly upon it. Thus, in the case of house lights particularly, where the usual load is but from ½ to ⅔ of the maximum, a meter of such a capacity that this would be its full rated load could be installed, thus obviating the inaccuracy caused by running upon a light load were a meter of capacity equal to the maximum load installed. As stated before, light loads for long periods constitute the revenue producer, and particular attention should be given to the fact when installing the meter.

The mistake is frequently made of thinking that once a meter is calibrated and installed, it will go on recording accurately for an indefinite period without receiving the least attention. Such, however, is not the case, which is apparent upon a moment's thought. Dust and an accumulation of dirt upon the commutator in the case of meters with brushes, and particles upon the disc which come in contact with the pole pieces of the magnets, are conditions under which any delicate mechanism would fail to operate. It is almost impossible to prevent the ingress of dust, and sometimes insects, which make the meter their home without regard to potential present.

An annual inspection, at least while on the line, is therefore necessary. The meter should be thoroughly cleaned and overhauled and at the same tested under its normal running conditions and its reliability determined, future purchases being regulated thereby.

The meter merits our warmest sympathy. It is frequently the most abused piece of apparatus in existence. I refer to its character being so rudely mutilated by many customers whose anger have been aroused by some mistake usually effected by themselves. My experience has been that 9 out of 10 complaints are based upon some mistake which can be traced to the customer, who, however, loses no time in denouncing the meter as inaccurate without considering the matter in order to arrive at the truth.

A meter usually bears an unenviable reputation in the mind of the general public, the reason of which is probably due to the principal complainants, old flat rate customers, who having acquired the habit of burning light needlessly under the old system, find it hard to curtail when placed upon a meter. Their bills naturally in the winter months run up to an alarming height. A good plan when dealing with an intelligent customer is to make him familiar to a certain extent with the mechanism of the meter, explaining the method of reading the dials so that he may check his own meter if he so desires. It takes but little time, and the result of enjoying the confidence of your customer fully justifies the time so expended.

In conclusion, I may say that my experience has been that a meter treated in a proper manner constitutes a most satisfactory and honest servant to the consumer and company in whose service it is employed.

DISCUSSION.

Mr. Chambers remarked that he had listened to the paper with much pleasure. He referred to the difficulty under which they labored regarding government inspection of meters. It not only formed a large item of expense, but was a drawback as regards testing meters while on the line, as the seals had to be broken, unless the meters were provided with windows. He said that he had recently received a pamphlet from the Canadian General Electric Company advocating the inspection and testing of meters four times a year. He thought that if meters required the amount of attention, as advocated by the pamphlet, they had better be abolished, as the inspector's fees and expense of removing meters from line would offset any advantages of a meter system over the flat rate system.

Mr. Huntress, while agreeing in a measure with Mr. Chambers, favored the government inspection of meters. The fact that a meter had been inspected, and its accuracy certified to by a representative of the government, relieved the company from the usual charges of fraud. The seal of the inspector settled at once any difficulty arising between customers and company. The quality of meters was improving, and consumers were becoming more cognizant of their value. Mr. Huntress also considered it good practice to make the consumer as familiar with the mechanism, etc., of the meter as possible.

Mr. Miller stated that he had tried for years to familiarize people with both gas and electric meters, and had failed to accomplish the desired results.

Mr. Chambers, referring to his previous remarks, said that he offered no positive objection to the inspection of meters when necessary, but questioned the necessity of so doing four times a year.

Mr. Miller, in supporting Mr. Chambers, said it was impossible to inspect them so frequently; it was not necessary, his experience having been that in the majority of cases meters, after two or three years' use, recorded as accurately as when installed, depending, of course, upon the location in which they were placed. Meters, he thought, were not as delicate as was generally supposed. He related an instance where a meter, while being installed, fell a distance of 20 feet without impairing its accuracy to any extent.

Mr. Siebert also questioned the delicacy of the mechanism of a meter, expressing the opinion that manufacturers did not expect the instructions regarding the handling of meters to be taken literally. The precautions were to prevent careless people from subjecting them to extreme violence.

Mr. MacKeen took issue with both Mr. Miller and Mr. Siebert regarding delicacy of meters, supporting his contention by explaining briefly the theory of their operation.

Mr. Freeman expressed the opinion that meters might be tested and sealed by government officials at the works of the manufacturers, and thus save central stations the trouble caused as at present. Mr. Freeman also asked for information regarding the life of the meter.

Mr. Smith explained the reason why meters were not sealed by government inspectors at the factory. The main object of testing when received was to adjust any possible error in its accuracy, caused by rough handling during transportation.

Mr. MacKeen, in replying to Mr. Freeman, stated that the life of a meter depended entirely upon the work imposed upon it, as far as the jewel was concerned. New jewels, however, could be inserted when necessary, the period of usefulness being practically unlimited.

Mr. Crosby, in reference to the accuracy of meters, cited instances where meters had been found perfectly correct after a continuous service ranging from two to three years.

Mr. Miller said that new jewels could be inserted without disturbing the government seal, in this way overcoming the expense of again sealing them.

Mr. Freeman then moved, seconded by Mr. Chambers, that a vote of thanks be tendered Mr. MacKeen. Carried unanimously.

Mr. J. H. Winfield submitted the following interesting paper:

THE LONG DISTANCE TRANSMISSION OF SPEECH.

By J. H. Winfield.

Long distance work is every day becoming a more important factor in the telephone business, and toll lines, instead of (as a few years ago) being regarded as mere accessories to the city exchanges, are now recognized as absolute necessities. We are talking over longer distances almost every month. A few years ago 500 miles was considered quite a feat; today we have conversations carried on over 1900 miles of wire with perfect ease. In view of this, it may not be amiss to speak of a few of the difficulties that are encountered in the design, construction and operation of these long lines.

The apparatus used in making a toll line connection may be divided into three parts: (1) the line; (2) the instruments; (3) the switching apparatus. The chief factor in extending the talking limit has been the improvement in the lines. Grounded circuits of iron wire are now practically obsolete, the recognized standard being a metallic circuit of hard drawn copper wire, generally No. 10 B. & S. weighing 170 pounds to the mile, but sometimes for short distances of No. 12 weighing about 104 pounds to the mile. The New York & Chicago line is constructed of wire weighing 435 pounds to the mile, but that is an exceptional case.

In speaking of the line I shall confine myself to the electrical rather than the mechanical difficulties that have been met with and overcome. Our object is to so construct the line and arrange the apparatus that the sounds at the receiving end shall possess the following characteristics: Loudness or volume; clearness; quality. Of these three clearness is by far the most important, for a faint sound, if clear, is perfectly intelligible, and a change in quality may only have the effect of disguising to some extent the speaker's voice. Volume is affected by any conditions which alter the amplitude of the wave.

Clearness is affected by any conditions which alter the position of the waves in regard to each other. Quality is affected by any conditions which alter the form of the wave. Therefore, the volume is reduced by resistance, leakage, static induction and self induction, the effect of these properties being to reduce the amplitude of the wave.

Clearness is reduced by static induction, and self induction, these tending to alter the inter-relations of the waves; static induction causing a rounding off of the top of the wave, thereby involving a loss of sharpness, while both static induction and self induction produce an unequal retardation of phase for vibrations of different periods, thus causing interference and a resulting deformed wave. In other words, the telephone current, being an alternating current of a frequency varying from 200 to 1,500 periods per second, according to the sound produced, static induction and self induction produce a greater retardation on the waves of high frequency than on the lower ones, thus mixing up the waves to some extent and rendering the speech muffled.

Quality is changed by all the properties which reduce the clearness, and by self induction in another sense as well, this effect of self induction being to reduce the amplitude of the overtone waves to a greater extent than of waves of a longer period.

Evidently then, in order to accomplish good telephonic transmission of speech, we must make the self induction and electrostatic capacity of our line and apparatus as low as possible, resistance and leakage being of less importance, though, of course, they should not be lost sight of. A small and well distributed leakage is often an advantage, as it allows the static charges to escape, clearing the line and to some extent neutralizing the effect of capacity, the slight loss in volume being more than counterbalanced by the gain in clearness. When iron wire is used there is a much further deformation of the waves than is caused by the increased resistance, due to the fact that the wire is circularly magnetized and this magnetism has to be reversed twice in every vibration. There is also a considerable increase in self induction due to the magnetic properties of the metal.

The self-induction of a copper metallic circuit of No. 10 or 12 wire is very small, but the self-induction of the apparatus which always forms part of a telephone circuit is sometimes very high and has a considerable effect on the current. Long distance lines would be particularly liable to disturbance from cross-talk if no means were taken to prevent it. There are two cases in which cross-talk will not be produced on a metallic circuit by a neighboring wire. The first is when the disturbing wire is at an equal distance from each of the wires of the metallic circuit. Were it always possible to string wires in this manner, there would be no trouble from cross-talk ; but a little consideration will show that this is only possible for two circuits. The second method is known as transposing. The two wires of the metallic circuit are transposed at regular distances, or, in other words, they change places, A changing to the pin B was on and B going to the pin A was on, the effect being to place each wire of the circuit at an average distance from the disturbing wire or wires. As the number of wires on a pole increases, the difficulty of planning the transpositions increases also. With two circuits it is an easy matter ; if, however, we have a third and transpose it, the same as we did the second, there will be cross-talk from the second to the third, because their relations to each other are the same as if there had been no transpositions at all. To get over this difficulty we must transpose the third twice as often as we did the second. A fourth circuit may be transposed at the middle points of the third, and so on. It has not been found necessary to transpose each circuit so that the induction currents are exactly balanced, and it is possible to use the same transpositions for every second crossarm, so that the first, third and fifth are alike, also the second, fourth and sixth. Transpositions are usually placed half a mile or a mile apart.

There has been very little change in the instruments in the past few years. The transmitter usually used is of the "Hunning's" type, and is known as the solid back ; it does its work remarkably well. Some of them require a little attention now and then on account of the packing of the carbon granules, but a judicious tap generally puts matters to rights. The ringer magnets of the call bells should be wound to a resistance of 1,000 ohms on long spools, bringing the wire close to the core, and thus giving them a high co-efficient of self-induction, which effectually prevents any shunting of the high frequency telephone current, while allowing the ringing current to pass freely, the ringers being bridged across the circuit.

In order to connect a metallic circuit to a grounded line, what is known as a repeating coil or transformer must be used, otherwise the balance of the circuit would be destroyed and the line become noisy. This piece of apparatus is nothing more than a specially made induction coil, the metallic circuit being connected to the primary and the grounded line to the secondary, the other end of the secondary being put to ground. In connecting together two metallic circuits through an intermediate office, the connections should be so arranged that the lines are directly connected, and the two transformers cut out ; otherwise, as a transformer only has an efficiency of from 85 to 90%, there would be a serious loss in volume.

All apparatus at intermediate stations should be bridged across the lines and the parts that are permanently in connection should have a high self-induction in order to avoid shunting the telephone current when the line is being used to stations farther on. Ring off drops should be wound to 1000 ohms resistance and also bridged. It is a good plan to use a tubular drop, as it not only increases the self-induction, but it also tends to prevent cross talk between the coils themselves, which is a frequent cause of disturbance and often not suspected.

Long distance lines should always be well equipped with protective devices. The best form for protection from lighting consists of two carbon blocks, separated by a thin sheet of perforated mica, one block being connected to line and the other to ground. These have proved very efficient and when properly installed generally prevent any damage to instruments or transformers. They also prove useful in another respect, as the static charges seem to find their way across from one plate to the other, clearing the line to a great extent. Many lines could be improved by a judicious use of these protectors at different points, such as the way stations. A fuse is also generally inserted in order to prevent the entrance of heavy currents which might otherwise do considerable damage, when, as sometimes happens, an electric light or power wire comes in contact with the circuit.

In regard to the operation of toll lines, long distance telephony is much more expensive than telegraphy, as may easily be seen when we consider that a single iron telegraph wire can easily transmit forty messages per hour, and when duplexed the number is doubled ; whereas in the telephone work we have to use two wires, and they must be of copper instead of iron, and even then under the best conditions it is hard to get more than seven or eight messages through in an hour. Add to this the fact that the sender of the message is aware of every minute of delay, and is usually very impatient when he has to wait a few minutes for the line, where in sending a telegram he just hands it in at the office and thinks no more about it, even though the message may not be sent for half an hour or longer, and it is easily seen that not only must the telephone message cost more than a telegram, but the lines are apt to be choked with business during a few hours in the middle of the day and comparatively idle the rest of the time. A great deal can be done by keeping the subscribers posted in reference to the hours when the lines are rushed, and very often they can so arrange their business that it will not come in the rush hours. They would thus save themselves the annoyance of having to wait for a connection and the lines would be worked more steadily.

DISCUSSION.

Mr. Hamilton opened the discussion by referring to the valuable character of the paper. He expressed his surprise that telephonic communication between cars on trains had not become more popular.

Mr. Freeman stated that telephones were used for that purpose in Pennsylvania, U. S.

A vote of thanks was tendered to Mr. Winfield for his paper.

The President then introduced Mr. Pickles, who submitted a paper giving a brief history of electric lighting in Halifax :

HISTORY OF ELECTRIC LIGHTING IN HALIFAX.

By W. Pickles.

The first electrical lighting in the county of Halifax for other than experimental purposes was an isolated plant owned and operated by the Dartmouth Rope Walk Co., of Dartmouth. It was not till the year 1881 that it was used in Halifax, and then only for an exhibition ; thousands of people thronged the wharf of Lawson Harrington, where the dynamo was in operation, but owing to an open circuit the exhibition was not the success anticipated.

About a year later a company was formed, under the name of the Halifax Electric Light Company—Mr. J. Logan, superintendent—with a station on Black's wharf. The installation consisted of one T.H. arc machine and ten arc lamps, shortly increasing to thirty-five street lamps and forty commercial, at the same time installing one Siemens alternator with a capacity of fifty incandescent lamps. This machine was used to light the Halifax Club.

In a few months it became evident that the present station was much too small to meet the growing demand for this new system of illuminating. The company decided to erect a larger and more modern station at the Three Mile House, at the outskirts of the city.

About this time the Halifax Gas Company decided to enter the field of electrical illumination, and with this in view purchased the apparatus, rights and good-will of the Halifax Electric Company. They immediately increased the capacity of the plant by the addition of two 50-light Wood arc machines. Strange to relate, however, within an exceedingly short time another company was formed under the name of the Chandler Electric Light Company. This company commenced operations with two stations, one situated at Messrs. Henderson & Pott's paint factory, and the second one at Dempster's planing mills. Their plant consisted of Ball machines, operated by the engines of the respective factories, the company being successful in securing the contract for the street lighting of Halifax. After being in operation for a short while, they decided to remove their apparatus to the head of the Northwest Arm, where water power was used when available; but, owing to the scarcity of water, steam was almost exclusively used. After operating this station for about a year, and not being as satisfactory as expected, they again moved their apparatus to Black's wharf; after a brief period of time and owing to uncertain conditions, they changed their name to the Halifax Illuminating & Motor Company.

The gas company at this time were operating incandescent lamps, and the Halifax Illuminating & Motor Company, in order to successfully compete with them, decided to install incandescent apparatus, which necessitated their removal to Moran's wharf, where more spacious accommodations were acquired.

Halifax at this time was laboring under the unsatisfactory service rendered by the horse car system of transit, and Halifax promoters, inspired by the successful operation of electrically equipped street cars, formed a company under the name and title of the Halifax Electric Tramway Company, for the purpose of converting the motive power to that of electricity. In order to centre the electrical industries, arrangements were completed whereby this new company absorbed the Halifax Illuminating & Motor Company, thus combining the incandescent and arc lighting systems with that of the street railway. The wisdom of this is evident from the fact that the operation of street railway in conjunction with incandescent and arc lighting systems reduces the cost of operation to a minimum. It must be borne in mind that the gas company was still operating the Three Mile House plant and a sub-station at the gas works, the electrical department being under the supervision of Mr. P. R. Colpitt.

Shortly after the formation of the Halifax Electric Tramway Company, a new company appeared upon the scene, under the name of the People's Heat & Light Company, which finally absorbed the Halifax Gas Light Company and erected gas works on the Northwest Arm. This company disposed of the electrical apparatus previously operated by the gas company to the Halifax Electric Tramway Company, thus further combining the electrical interests.

In conclusion, it may be of interest to those present to give a brief description of the apparatus at present being operated by the Halifax Electric Tramway Company, under the management of Mr. F. A. Huntress. The apparatus consists of 900 k.w. for railway, 800 k.w. for incandescent work, and 250 k.w. for arc lamp service, operating thirty-two cars, 14,500 incandescent lamps, 240 arc lamps, and 300 h.p. in motors.

I have endeavored to give a brief history of the many changes that have taken place in the electrical industries of this city, and feel that it is impossible to do justice to this subject in so short a paper. If it has proved of interest to any present the object has been fully realized.

DISCUSSION.

Mr. Colpitt, in commenting upon the paper, stated that it brought many old recollections to mind. He related some interesting anecdotes in connection with regulating the voltage of an old Siemens alternator, a reel of iron wire with a poker as a contact maker being used in lieu of a regular rhoestat.

A hearty vote of thanks was then tendered to Mr. Pickles.

Mr. Bowman, in concluding the business of the convention, expressed his pleasure that so many valuable and interesting papers had been submitted. He felt that if the present interest manifested were sustained the Association would enjoy a long and brilliant career.

The President then declared the convention adjourned until next annual meeting, the date and place to be announced later.

THE BANQUET.

In the evening the Halifax members tendered the visiting delegates a banquet at the New Victoria Hotel. The arrangements were complete, and the unanimous opinion was that the affair was a great success and a fitting conclusion to the convention. Amid pleasing decorations the company sat down to dinner at 9 o'clock, when the following repast was furnished:

MENU.

"High Potential Transformer."
George's Island Punch. 30,000 Volts.

SUBMARINE CABLES.
Oysters on the Deep Shell. Consomme a la Nova Scotian.

TROLLEY POLES.
Baked Philadelphia Trout, Sauce Piquant.
Windsor Potatoes, "Self Regulating."

INDUCTIVE LOAD.
Queen Olives, "Rubber Covered." Lettuce.
Fillet of Beef, with Mushrooms a la Lyonnaise,
Croquant of Lady's Fingers, with Charlotte Russe.
Tutti Frutti with Whipped Cream.

SHORT CIRCUITS.
Westphalia Ham. Champagne Sauce "a la Overload."
Ox Tongue, Pecking Sauce, "High Potential."

JOINTS, "Soldered and Taped."
Haunch Prime Western Beef. Dish Gravy, "Lubricating."
Young Turkey, "Low Resistance." Oyster Dressing
Lemon Jelly, "Insulating Compound."

HEAVY GROUNDS.
Whole and Mashed Potatoes, a la Creme.
French Peas, "Copper Plated." Bermuda Onions, "High Permeability." Beets.

SHUNTS
Mayonnaise Jelly, "Vibratory." Lobster Salad, "Iron Armoured."

BOOSTERS.
English Plum Pudding, "Sound Proof." Sauce Cognac, "Circuit Breaker."
Snow Ball Pudding, "Light Load." Soft Custard, "X Ray."
Apple Pie, "Rubber Belting." Lemon Meringue Pie.

DESSERT.
Vanilla Ice Cream, "Self Ventilating."
Assorted Cakes, "Polyphase Currents."
Apples. Oranges. Layer Raisins, "Shellaced."
Nuts and Bolts. Confectionery, "Insulators."
ELECTRIC HEATERS—Cafe Noir, Tea.
BLOW LAMPS—Cigars, "Soft Cured."
CHANGE CARS! TROLLEY OFF!! LINE DOWN!!!
TOASTS. SPEECHES.

President-elect Huntress occupied the chair. An informal toast list included "The Queen," "Our Past-President," "Our Guests," and "The Newly-Elected Officers," each of which brought forth fitting responses. Messrs. N. L. McDonald, C. Mitchell and A. Norman favored the company with songs, and music was discoursed by the Mystic orchestra.

MOONLIGHT SCHEDULE FOR MAY.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 7.20	A.M. 1.40	6.20
2....	" 7.20	" 2.20	7.00
3....	" 7.20	" 2.50	7.30
4....	" 7.20	" 3.20	8.00
5....	" 7.30	" 3.50	8.20
6....	" 7.30	" 3.50	8.20
7....	" 7.30	" 3.50	8.20
8....	" 7.30	" 3.50	8.20
9....	" 7.30	" 3.50	8.20
10....	" 7.30	" 3.50	8.20
11....	" 7.30	" 3.50	8.20
12....	" 7.30	" 3 50	8.20
13....	" 7.30	" 3.50	8.20
14....	" 10.20	" 3.50	5.30
15....	" 10.50	" 3.40	4.50
16....	" 11.00	" 3.40	4.40
17 ...	" 11.20	" 3.40	4.20
18....	" 11.50	" 3.40	3.50
19....	....	" 3.40	3.30
20....	A.M. 12.10	.....	
21....	No Light.	No Light.	.....
22....	No Light.	No Light.	.....
23....	No Light.	No Light.	.....
24....	No Light.	No Light.	.....
25....	No Light.	No Light.	.....
26....	P.M. 7.40	P.M. 10.10	2.30
27....	" 7.50	" 11.00	3.10
28....	" 7.50	" 11.40	3.50
29....	" 7.50	A.M. 12.10	4.20
30....	" 7.50	" 12.50	5.00
31....	" 7.50	" 1.00	5.50
		Total.........	155.10

Tenders were recently invited for the supply of an electric light plant for the new municipal buildings, Toronto. The Canadian General Electric Company were the successful tenderers, their price for a 100 k. w. generator being $4,287. The contract for electric wiring was given to the Bennett & Wright Company, at $2,250.

THE ELECTRICAL INDUSTRY IN BRITISH COLUMBIA.

A visitor to Toronto within the past month was Mr. L. A. Campbell, manager of the West Kootenay Power & Light Co., of Rossland, B. C. Mr. Campbell also spent a few days in Montreal, in consultation with some of the directors of his company. Talking with a representative of the ELECTRIAL NEWS, Mr. Campbell stated that many of the mines in British Columbia had lately been closed down for the purpose of increasing their equipment, and that in a short time they would be turning out ore in large quantities. Operations were being carried on day and night, eight hour shifts being employed. He remarked that much electrical apparatus had been installed in British Columbia during the last two years. At Rossland, for instance, motors of a total capacity of 2,600 h.p. were now connected up, the power being used for lighting and hoisting purposes. A 300 h.p. hoist was now in operation at one of the mines, and the owners of the Le Roi purposed putting in one of 500 h.p. The plant of the West Kootenay Power & Light Co., which supplies light and power almost exclusively for mining operations, has been steadily in operation since July last, and Mr. Campbell states that no trouble whatever has been experienced with climatic conditions. The distance from the power station to the sub-station at Rossland is thirty-one miles, but a motor is fed four miles beyond the sub-station, making the entire distance from point of development to end of distribution line thirty-five miles. The line passes through a rough section of country, including many high hills. It was learned that the West Kootenay Power & Light Company are about to install another 2,000 h.p. machine, thus doubling their capacity, this course having been rendered necessary by the steadily increasing demand for power. It is also the purpose of the company to extend their line to the boundary country and Greenwood Camp, seventy-two miles distant from the generating system, for the purpose of supplying power for the different mining properties in that district. In this connection it is interesting to learn that it is contemplated to use a pressure of 34,000 volts, the highest yet attempted in Canada. Mr. Campbell will look over the ground at an early date and report to the directors of the company.

POLE SETTING.

No definite rule can be given for the depth at which poles should be set in the ground. The character of the soil, the distance between poles, the number of wires carried, and the sharpness of the turns made in the line must all be considered in determining this question. For average work we would point out the following table, which we believe to be in accordance with the best practice:

25	foot	pole	5½	feet	in	ground.
30	"	"	6	"	"	"
35	"	"	6	"	"	"
40	"	"	6	"	"	"
45	"	"	6½	"	"	"
50	"	"	6½	"	"	"
55	"	"	6½	"	"	"
60	"	"	7	"	"	"
65	"	"	7	"	"	"
70	"	"	7½	"	"	"

Where the ground is bad, or where the conditions are very severe, the holes should be larger than usual, and about six inches of concrete, composed of broken stone, sand and enough cement to bind them together, should be placed in the bottom. The pole should then be put in place and the hole filled in with the same mixture, which should be thoroughly tamped into place.

It sometimes happens that a pole cannot be set deep into the ground on account of some sewer, subway or other obstruction. In such cases the hole should be dug as deep as possible, and considerably larger than would ordinarily be necessary. The pole should then be set in place and its end thoroughly embedded in a mass of stone and cement entirely filling the hole. If the strain is at all severe, the pole should be thoroughly guyed in addition to the above precautions.

Great mistakes are often made in laying out pole lines by introducing unnecessary turns in the line. It should be remembered that where a line is straight the tendency of the wires when properly strung is simply to press the poles deeper into the ground. But where a bend occurs in the line an enormous side strain is present which tends to either break or loosen the pole. The magnitude of these strains can only be appreciated by those who have had actual experience in this work.

In running a line over undulating country it should be borne in mind that the poles in a hollow of the ground should be long and those on elevated positions comparatively short, the object being to avoid very great upward and downward curves in the wire. Where this precaution is neglected it is frequently found that the insulators are pulled off the pins and dangle several feet above the cross-arms, and frequently a short pole in a low position is pulled entirely out of the ground.

The butt of the pole should always be squared before setting.—The Telephone.

THE MEASUREMENT OF HIGH RESISTANCES BY THE WHEATSTONE BRIDGE.

By A. O. Benecke.

High resistances are usually measured by the deflection method, as the range and the insulation resistance of the Wheatstone bridge is not sufficient for this purpose.

It is, however, possible to use the Wheatstone bridge method for measuring resistances up to a thousand megohms even with greater accuracy than obtainable by the deflection method by simply measuring the high unknown resistance in multiple to another suitable resistance.

Suppose we have a five dial bridge and a resistance of say about 100,000 ohms. We can measure this resistance on the bridge accurately to single ohms. It may measure A ohms. Now we place the unknown high resistance in multiple and find the combination is balanced by B ohms. Then we have

$$\frac{A.\,x}{A+x} = B, \text{ or } x = \frac{A.\,B}{A-B}$$

In this result a surface leakage of the bridge is eliminated, as it is already contained in A.

In case A = 99988 ohms and
B = 99978 ohms, we find
x = 1,110,722,254 ohms, or
1,1111 megohms.

This method of measuring an unknown resistance in multiple arc to another one will be found also very useful for the measurement of such resistances which otherwise would necessitate the employment of ratio coils widely differing in value. The sensibility of the galvanometer, and therefore the accuracy of the measurements on the bridge, is, as it is well known, the greatest if the four arms of the bridge are of the same resistance, i. e., if the ratio of the proportional coils is 1. If we want to make our measurements under these best conditions the range of a five dial bridge would be limited to 10,000 ohms. For the measurement of 1 megohm, we would have to use the ratio 100 : 1, but measuring the 1 megohm in multiple to 10,000 ohms we still could use the ratio 1 : 1.

MONTREAL

(Correspondence of THE CANADIAN ELECTRICAL NEWS.)

FOOD FOR THOUGHT.

A leaflet entitled "Food for Thought" has come before the notice of your correspondent. It consists of some extracts from remarks made by the Chairman of an Electrical Contractors' Association in an American city. Judging by the figures submitted for electrical work in Montreal, it is equally applicable to this side of the border. For instance, when tenders were opened a few days ago for the wiring of a public building, one tender was $250, another $235, and the third, and needless to say successful tender, was $70. I am credibly informed that the material alone for the work cost the contractor over $100. Let me give you another instance: Four tenders were submitted, $10,000, $9,500, $8,200 and $3,600. The latter tender was, of course, accepted, but the compliers of same found that they had missed a "small item of $6,000," much to their subsequent sorrow. Herewith are given extracts from the leaflet, which I seriously recommend to the electric wiring contractors of Canada:

"I should like to make a few general but not personal remarks before opening for regular business.

A few of the members are old-timers in the business, and I think they will bear me out in some of the statements I am about to make.

I think I can truthfully say that $150,000.00 will not cover the losses in the electrical fraternity, during the past few years, in this city alone.

There was a time when this business was a profitable and pleasant one. What is it now? You may possibly be grubbing out an existence—no more. Undoubtedly some are glad to get that. I am for one. At the rate you are going you will not be able to gather that in, in a very short time.

It is the old story told and re-told a lesson taught but never learned. It will not take long to tell why we are now at the bottom of the ladder; round by round we have gradually descended. Low prices for material and for work have been the ruination of several in this city, and many in other cities.

The old worn-out saying so familiar to the old-timers, running something like this—"I will do up this and that concern, and soon I will be alone in the field to reap the benefit of my shrewdness." This makes the old-timer smile, for he knows that he has helped bury more than one.

The method adopted by the new-comer to him seems new. It is—as he reasons with himself—I am new on the ground and to get business and a little reputation I will cut the prices. I will do the job at cost.

What does the old-timer do when he sees trade drifting away. He cuts also, only a little more. The student has his war-clothes on and he proposes to show that he is no chump, and he goes one better. Down the ladder you go and the fight goes merrily on. What is gained? Nothing—the prices are down and never to be brought back. What is the next step—some one gets tired, is running behind with his credit, and a bold stab is made. Call on the stockholders, fire the worn-out partner, get a new partner or shut up shop. And the band still plays on. If one concern digs a big hole, crawls in and pulls the hole after him, he is not missed, but he is not forgotten. The warriors left on the field of battle are resting up. Along comes another, green in the business, but seeing fabulous wealth in a business that is still in its infancy, dumps his load of dollars in the hopper, and with the keen scent of a tried and true fighter follows in the steps of the departed.

Same old story that makes us all weary is again gone over and the fittest survives, but badly wounded. After all the wasted years you have laid nothing by; you are poorer in pocket and health, and you are finally carried to your long, last resting-place and the head-stone over your grave should be lettered—A life wasted in the electrical business that future generations can look with reverence on the burial place of one who fought well but not wisely.

Undoubtedly I shall be the first one of members present who will retire from the field, but do not think that my place will not be taken. I will not be missed but I can rest on my oars and look back at the poor deluded mortals fighting and worrying for their daily bread in a business that has been ruined in its infancy. There is but one more round in the ladder for you to descend and then you are on the last; grip that and thank God that you are alive."

NOTES.

Mr. R. A. Ross, E. E., of this city, has left for a three months' sojourn in China, where he will be in consultation with Sir Charles Ross re electric power transmission in that country.

I note that Prof. Carus-Wilson, recently head of the Electrical Department of McGill University, Montreal, has taken an active part in recent discussions at the Institution of Electrical Engineers in London, Eng.

Mr. W. J. Plews, assistant to Mr. Badger, the expert for the Fire Underwriters Association in this city, has lately got out a form of main switch, or what at sight might erroneously be termed a circuit breaker. He has the article patented in five countries, and is likely to make a good thing out of it, as those who have seen it practically tested speak very highly of it. It opens with excess of voltage, even on one side. It will thus be seen that it is invaluable as a precaution when a transformer breaks down or when a high voltage line of any kind falls across the house mains.

QUESTIONS AND ANSWERS.

"F. B." writes: Will you kindly have the following question answered through the columns of your valuable paper: I have an E. P. Allis 14 x 36 Corliss condensing engine, of which the crank end valve carries (not released) over 5 h.p. before the head end. Card at proper load shows lead, compression, etc., all right. Of course, the crank end doing less work than the head end might cause it on overload to carry over first, but should there be the above difference? Can it be remedied except by changing cams?

ANSWER.—As we understand the question, you wish to know if the difference in the horse power developed at the two ends is greater than it should be. With an engine of this size, the difference is scarcely greater than might be expected, and we do not think there is anything seriously wrong with the engine.

"Re-Winder" writes: In an induction fan motor, can you tell me if a change in frequency would mean more or less copper bars inserted through the squirrel-cage rotor? Am trying the experiment of making 16,000 A. fan work on 8,000 A.

ANSWER.—The "squirrel-cage" rotor would be the same for both frequencies, but we do not think that the change as proposed is commercially practicable. It would cause the motor to heat beyond a safe point, due to the greater magnetic flux which will be necessary, and to the somewhat increased current taken. It will also be found that the speed will be a little less than half of what it should be to give a reasonable breeze.

DIFFERENCE BETWEEN THE NOW AND THEN.

Prof. Elisha Gray delivered an address at a recent convention of the Northwestern Electrical Association at Duluth, entitled "Reminiscences and a Glimpse into the Future," in which he introduced the following verses:

In the olden time along the street,
  A glimmering lantern led the feet,
When on a midnight stroll;
  But now we catch when night is night,
A piece of lightning from the sky
  And stick it on a pole.

Time was when one must hold his ear
  Close to the whispering voice to hear,
Like deaf men near and nearer;
  But now from town to town he talks,
And puts his nose into a box,
  And whispers through a wire.

In other days we took a car,
  Drawn by a horse if going far,
And felt that we were blest;
  But now the conductor takes the fare
And sticks a broom-stick in the air—
  The lightning does the rest.

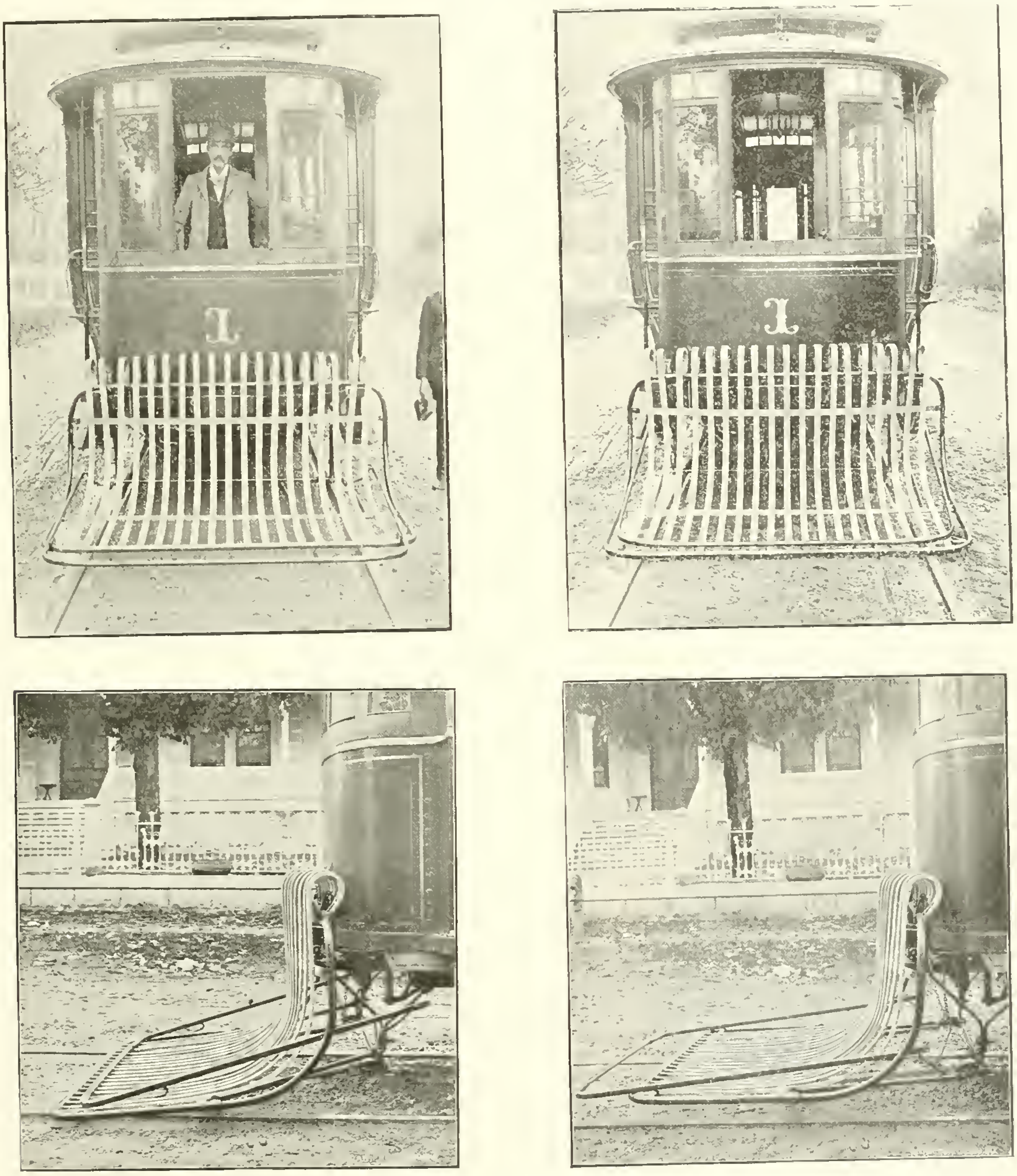
Just as we go to press we learn of the death of Mr. Donald Gibson, city electrician of Toronto, in his 74th year. Mr. Gibson entered the city service in 1872, and was one of its oldest employees. Under his superintendence the excellent fire alarm service in use was developed, and brought to its present condition.

The Dominion Publishing Company of Toronto have just completed a handsome publication entitled, "Canada from Ocean to Ocean." The work is descriptive of the resources of the various provinces of the Dominion, and is liberally illustrated with many beautiful engravings of the public buildings, leading industrial establishments, etc., throughout Canada. We understand that the publication of this work, which is in every way creditable to the publishers, is approved and assisted by the Dominion and provincial governments, and the leading municipal corporations. It will be placed in the Boards of Trade and public libraries throughout Great Britain and Canada, on the leading steamships, and in other places where it will be likely to prove a valuable advertisement for this country.

ELECTRIC RAILWAY DEPARTMENT.

AN IMPROVED STREET CAR FENDER.

On this page illustrations are presented of an improved street car fender invented by Mr. Geo. Sleeman, and manufactured by the Geo. Sleeman Fender Co., of Guelph, Ont. From the views shown the reader will clearly understand its construction and operation.



Views of Street Car Fender, Invented and Manufactured by Mr. Geo. Sleeman, Guelph, Ont.

The fender is positively automatic, an advantage which it is claimed to possess over all other fenders in use. In front of the fender is a projecting guard, by which it is rendered automatic. When the fender is carried the usual height from the track, say eight inches, the guard projects about one foot. When this guard comes in contact with any obstacle, it is driven back, and the fender falls quickly to the track, thus preventing the obstacle from being passed over by the car. The fender is always down to the track before the object is reached, the fall being quickened by the tension of two strong spiral springs. By pulling the guard forward when the fender is down, the fender rises to the proper height from the track, where it remains until the guard is again struck.

This fender has been favorably received and commented upon by street railway people. It is used on the cars of the Guelph street railway, has been recommended to the Toronto Street Railway Company by the city engineer, and within the past fortnight the manufacturers have closed a contract to equip with this fender all the cars of the Winnipeg street railway system.

One hundred open cars of new design are being built at the shops of the Montreal Street Railway Co. Besides adding extra cars, the company intend making them longer, with the result that the trailers will gradually become obsolete. This summer the company will build car shops at Hochelaga and also extend the system to Verdun.

CANADIAN ELECTRICAL STUDENTS' COMPETITION.

The publishers of the Canadian Electrical News hereby offer a first and second prize of $15 and $10 respectively for the best thesis submitted by an undergraduate of a Canadian university on any one of the following subjects, viz. :

1. "The Magnetic Circuit of Dynamos."
2. "The Incandescent Electric Lamp."
3. "The Electric Meter."
4. "The Relative Advantages of Low and High Frequency in an Alternating Electric Lighting Plant."
5. "A Concise Description of a Method of Testing Transformers for Efficiency at Various Loads, both as Regards Regulation and Core Loss."
6. "Comparison between Two and Three Phase Installations for the Long Distance Transmission of Power."

It is required that each thesis submitted in this competition shall consist of not less than 5,000 nor more than 6,000 words, and shall be written in the third person, and typewritten for publication on one side only of foolscap paper.

To admit of a fair comparison of the merits of the theses which may be submitted, keeping in view variety of subjects, a system of marks will be employed such as is generally used in college examinations, and with which the competitors in this competition are familiar. These marks will be allotted under three heads, viz.:—

1. Subject Matter.
2. Arrangement.
3. English.

Taking 100 as the combined total, the maximum and minimum marks for each of the above classifications will be as follows :

Maximum.		Minimum.
50	Subject Matter	25
25	Arrangement	15
25	English	15

If any of the theses submitted should not be entitled to receive the minimum of marks as above, they will be entirely rejected.

There are three sources from which competitors must draw their subject matter, viz., books, periodicals and floating literature, personal or private channels. In judging of the subject matter, the following relative values will be attached to the above mentioned sources of information :

(a) Books	10
(b) Periodicals and floating literature	20
(c) Personal or private sources	20
	50

Where extracts are used, their source and names of authors should be clearly given.

Where diagrams are required to illustrate the text, they should be drawn with pen and perfectly black ink on pure white drawing paper, bristol board or tracing linen, and in such manner as to admit of their reproduction to a small scale.

Each thesis shall be submitted by motto only, and shall be accompanied by the name of the author enclosed in a sealed envelope bearing the same motto. This envelope will remain sealed in the hands of the publishers until the competition shall have been decided.

Theses submitted in this competition must reach the C. H. Mortimer Publishing Company of Toronto, Limited, Toronto, Ont., publishers of the Electrical News, before the first day of October, 1899.

A competent judge has been chosen to decide the competition in accordance with the method explained above. This gentleman, whose name will be given at a later date, will no doubt be acceptable to all concerned.

The result will be published as soon as possible after the close of the competition.

The publishers of the Electrical News reserve the right to publish such of the theses submitted as in their judgment may appear to be desirable for that purpose.

SPARKS.

The Montreal Street Railway Co. have placed an order with the Canadian General Electric Co. for twenty C.G.E. 1,000 railway motors.

Provincial legislation will be sought to permit towns in Manitoba to install and operate electric light and telephone stations for commercial purposes.

The Canadian General Electric Company have just received an order from the Rubber Tire Wheel Co., of Springfield, Ohio, for a complete tire welding plant.

The Winnipeg Street Railway Co. have placed another order with the Canadian General Electric Co. for 18 of their standard C.G.E. 1,000 railway motors.

The amalgamation is announced of the Lakefield electric lighting plant and the Burleigh Falls-Lindsay electric power scheme, the promoter of which is Mr. J. A. Culverwell, of Toronto.

The Canadian General Electric Co. have received another additional order from the Montreal Cotton Co., of Valleyfield, Que., for one 200 h.p. and one 100 h.p. induction motors, also for one 20 h.p. motor of the inverted type.

The Royal Electric Company are installing in the works of the Hamilton Bridge Company one of their 40 h.p. two phase induction motors for operating the cranes and machinery. The works are also being lighted throughout by electricity.

The Toronto Electric Light Co. has entered an appeal in the Court of Appeal against the decision of the jury in the recent Civil Assizes awarding W. G. Harris $10,000 for a fire in his factory, alleged to have been due to a defective electric wire.

The Lachine Rapids Hydraulic & Land Co., of Montreal, have, during the past 30 days, ordered from the Canadian General Electric Co. induction motors of the following sizes : one 100 horse power, four 5 horse power, two 3 horse power, and two 2 horse power.

The Lunenburg Gas Co., of Lunenburg, N.S., through their manager, Mr. E. L Nash, are now offering to supply the inhabitants of Lunenburg and Mahone Bay with electric lights. As soon as their new power works at Mahone are completed, they will supply an all night service.

The British America Corporation, who control the Le Roi and other valuable mining properties at Rossland, B. C., have decided to equip these electrically for power and hoisting purposes, and have ordered four 150 h.p. special three-phase induction motors and controllers from the Canadian General Electric Co.

In connection with the Y.M.C.A., Montreal, an electrical society has been formed, with Professor L. A. Herdt, of McGill College, as teacher. The new society will hold monthly meetings during the summer for discussion, excursions and visits to electrical plants. Professor Herdt is president, and Mr. James C. Bray secretary-treasurer.

To close out the estate of the Eastern Townships Light, Power & Carbide Company, of Sherbrooke, Que., tenders were recently invited by John J. Griffith, liquidator, for the entire electric plant of the system at present supplying electric light to the villages of North Chatley, Eustis, Capelton, Waterville, Compton and Lennoxville.

The Grand Trunk Railway Company have decided to extend their electric system in order to furnish light and power to their new freight sheds, as well as their present repair shops. For this purpose they have placed an order with the Canadian General Electric Co. for two 500 light direct curennt multipolar dynamos, complete with marble panel switchboards.

The Gurney-Tilden Company, of Hamilton, are having installed in their works, by the Royal Electric Company, one 50 h.p., three 15 h.p. and one 7 h.p. "S.K.C." two-phase motors, which are to drive the machinery and elevators in their entire works, entirely replacing steam. At this rate Hamilton will soon be a smokeless city, as the Hamilton Electric Light & Power Co. were closed down on March 5th, and have not been in operation since, everything being driven by the large S.K.C. motors with power from DeCew Falls.

The Water Commissioners of the town of Fort William, Ont., have purchased from the Royal Electric Company an additional S.K.C. two phase generator having a capacity of 200 kilowatts. Their lighting has increased sŏ rapidly that the 75 kilowatt plant which was put in a year ago was not sufficiently large to supply the demand. They are also relamping a portion of the city and extending their lights. About 500 lights capacity of S.K.C. transformers are being put in. The changes will be made and the additional plant in operation about the middle of June, after which it is proposed to supply the requirements of the C. P. R. in their large passenger station, elevators, freight sheds, round houses, and the Kamanistiquia hotel. The growth of the lighting has been phenomenal, and has been taken care of by Mr. T. Ed. Oakley, secretary to the commissioners. The waterworks and electric light plant are in charge of superintendent W. H. Smith, formerly of Goderich, Ont.

PERSONAL.

Mr. Matthew Stanley, of Perth, Ont., has received the appoinment of superintendent of the street car shops of the Birmingham, England, tramway. This system is operated by a Canadian syndicate, Messrs. Wm. Mackenzie and James Ross being the chief members.

Mr. L. J. Breithaupt, manager of the Berlin Gas and Electric Co., has been chosen as the Liberal candidate to contest the riding of North Waterloo in the coming bye-election. The seat was made vacant through the unseating of the successful Conservative candidate, Dr. Lackner, of Berlin.

Mr. D. R. Logan, who was for several years connected with the Canadian Generel Electric Company and the W. A. Johnson Electric Company, has accepted a position with Mr. John Forman, dealer in electrical supplies, Montreal. Mr. Logan will act as travelling representative for Mr. Forman in Western Ontario, with headquarters in Toronto.

Mr. W. B. Chapman, who is interested in electrical enterprises in the West India Islands, returned to Montreal last month, after spending the winter in these British possessions. In Jamaica Mr. Chapman met Lieut. Col. Henshaw and Mr. W. Porteous, of Montreal, who are interested in the tramway system. Mr. Chapman states that upon his arrival in Kingston, the work on the electric tramway was well advanced, and that the citizens were delighted with the work the Canadian syndicate had done. The Kingston electric tramway is about twenty miles in length and twenty-eight cars are operated.

SPARKS.

The Canadian General Electric Co. have sold the West Kootenay Power & Light Co., of Rossland, B. C., one of their standard 50 h.p. three-phase induction motors.

The Guelph Light & Power Co. have placed an order with the Canadian General Electric Co. for one of their latest multipolar type 500 volt generators of 100 horse power capacity.

The Columbia Telephone & Telegraph Co., an American concern, will apply to the Dominion parliament for a charter to extend its system to all parts of British Columbia and the Northwest Territories.

The Metropolitan Electric Co. has been granted a charter for twenty-three years by the city council of Ottawa, Ont., for the supply of electricity for light and power purposes. The Deschenes Electric Co. have renewed their application for a charter, but the city council does not seem to be disposed to favorably consider it.

The John McPherson Company, Limited, manufacturers of boots and shoes, Hamilton, Ont., have placed their order for a 40 h.p. S.K.C. two-phase induction motor, which is to be used to operate their entire plant, replacing their present steam equipment. They are also having their factory lighted throughout by electricity.

The Cataract Power Co. have made a proposition to light the streets of Hamilton for ten years at the following prices: For the first 425 arc lights, $85 per lamp per year, and any additional lamps, up to 500, for $82.50 a year. If over 500 lamps are required at any time during the contract, the rate will be $82.50 for the first 500 light, and $80 for each additional lamp.

Mr. W. H. Kent, superintendent of the Vernon & Nelson Telephone Co. and the New Westminster & Berrard Inlet Telephone Co., states that important improvements to the system have been decided upon. An additional wire will be erected between New Westminster and Vancouver, and the old instruments replaced with more modern ones. A local exchange will be established at Greenwood City.

The Bell Telephone Co. is establishing a number of pay stations in Montreal on the nickel-in-the-slot principle. The instruments will be placed in drug stores, but the system will be distinct from the ordinary telephone in the store. The person who desires to use the instrument will call up central, but connection will not be made until five cents has been deposited in the slot.

The Lachine Rapids Hydraulic & Land Co. believe that the stealing of electricity is carried on to some extent in Montreal. In one instance, it is said to have been discovered that a saloon keeper who paid for about five lights had some twenty-five more put into his place, supplied by connections unknown to the company. Steps are being taken to prevent this practice. Under the new law of the State of Illinois, a conviction was recently obtained in Chicago by the Chicago Edison Co. Practical demonstrations of the use and measurement of electricity were given in court at the trial. Wires were connected on the witness stand with the electric wires of the building and apparatus attached. Expert electricians illustrated the art of "plugging," "cutting off," and "cutting in." The "cutting in" of the criminal court building wires and the flashing of a light full of force and brilliancy was considered a particularly apt and convincing illustration of how electricity might be stolen. The penalty in Illinois for thefts of this nature is a term of not more than three months in all and a fine not exceeding $500.

The town of Picton, Ont., opened tenders recently for additions to its electric lighting plant. The tenderers for alternators were the Central Construction Co., Buffalo; Canadian General Electric Co., Toronto; Royal Electric Co., Montreal; Munderloh & Co., Montreal; and Westinghouse Electric & Manufacturing Co., Pittsburg. For steam boilers the tenderers were E. A. Wallberg, Montreal; Robb Engineering Co., Amherst, N.S.; Babcock & Wilcox Co., Montreal; Goldie & McCulloch Co., Galt; and Central Construction Co., Buffalo. The tenderers on steam engines were the Goldie & McCulloch Co., Robb Engineering Co., and Central Construction Co. The Northey Manufacturing Co., Central Construction Co., Robb Engineering Co., and Goldie & McCulloch Co. tendered on pumps and condensers. For the supply of the complete equipment the only tenderers were the Canadian General Electric Co. and the Central Construction Co. The consulting engineer, Mr. Roderick J. Parke, of Toronto, has made a report to council, but the contracts will not be awarded until the by-law has been sanctioned by the ratepayers. A vote is likely to be taken early in June.

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SPARKS.

The Bell Telephone Co. will probably put in a metallic circuit at Orillia, at a cost of about $7,000.

The formal opening of the new electric light plant at the Mimico Industrial School, near Toronto, took place a few weeks ago.

The Bell Telephone Co. will build a new copper metallic line between Arnprior and Ottawa. Work will be commenced immediately.

The Canadian General Electric Co. have received an order from the Strathroy Electric Company for a 25 kilowatt 500 volt generator of their latest type.

The E. T. Wright Company, of Hamilton, manufacturers of tin and stamped ware, are having their steam engine replaced by a 30 h.p. S.K.C. two-phase motor, receiving its current from the lines of the Cataract Power Company.

The road masters of the Toronto Railway Company recently tendered a complimentary banquet to their superintendent, Mr. Gunn, at McConkey's restaurant. Mr. Gunn has been associated with the Street Railway Company for over thirty years.

Capt. G. H. Couverette, of Montreal, has patented an electric grain shovel, to be worked in connection with the floating elevators now in use in Montreal harbor. By the use of this shovel it is claimed that grain can be trans-shipped in less than half the time it has taken heretofore.

Incorporation has been granted to the Smart-Eby Machine Co., Limited, of Hamilton, Ont., to carry on business as iron founders and manufacturers of engines, boilers, pumps and other machinery. Mr. W. C. G. Smart, one of the company, was recently associated with the Jenckes Machine Company.

A canal boat propelled by electricity has been invented by Mr. H. L. Welsh, of Cowansville, Que. It is claimed that the boat will do away with the necessity for locks. At a recent meeting of the Amalgamated Hudson Canal Association, it was decided to offer a prize for a practical canal boat propelled by electric power, and Mr. Welsh hopes to obtain the prize.

Mr. Frank A. Cote, of the firm of Cote & Coursellés, electricians, Ottawa, has invented a new lightning arrester which he claims will greatly minimize interruptions of telephone service caused by wires coming in contact with those of stronger currents, and also prevent overheated wires from setting fire to buildings. Mr. Cote's invention was tested recently in the presence of experts of the Bell Telephone Co., and is said to have proved successful, the strongest currents being intercepted.

The record for long distance telegraphing is claimed to have been broken by the Associated Press on its regular system of wires leased from the Western Union Telegraph Company. A continuous circuit of six thousand miles, reaching from New York city to the Pacific coast, and from Chicago to New Orleans, was successfully worked for several hours. There were forty-one operators copying from a sender in New York, with 41 newspapers being served directly from this one circuit in thirty-eight of the leading cities of the United States.

The owners of the Wellington Extension Mine at Oyster Bay, B.C., have let a contract to Geo. C. Hinton & Co., of Vancouver, for a complete tramway and electric light system, the cost of which will be about $60,000. The electric tram lines will be about five miles in length, operated by two 150 h.p. generators, direct connected to two automatic high speed horizontal engines of same capacity. The contract also includes two standing mining locomotives of 100 tons capacity and the electric lighting of the entire mine. Messrs. Hinton & Co. will complete the contract this summer.

An English contemporary is responsible for the following: Everything industrial in Germany, as is well known, is carefully inspected and supervised by the authorities, but the education of these gentlemen is not always up to the average of that of their fellow-countrymen, as the following story shows. The other day a government official inspected an iron foundry, and remarked in his report to his superior that there was no incrustation in the boilers at the works. Upon which the superior, in evident disgust at what he considered a want of enterprise on the iron founder's part, at once issued the peremptory order: "The deficient incrustation of the boilers at this factory is to be remedied forthwith."

The West Kootenay Power & Light Co., of Rossland, B.C., have, in order to meet the demands for power, found it necessary to increase their generating plant at Bonnington Falls to double its present capacity. This company commenced furnishing power to its customers a little over one year ago, and to-day have their two 1,000 h.p. generators loaded to their fullest capacity. This speaks well for the management of the company, who deserve to be congratulated on the success of a venture such as they have undertaken in transmitting electric energy successfully over a distance of nearly 40 miles. They installed originally two 1,000 h.p. three-phase revolving field generators of the Canadian General Electric Company's type, and have recently placed an order with the same company for one 2,000 h.p. machine of the same type, together with marble panels, switchboard, etc. They have also ordered from the Canadian General Electric Co. 3,000 kilowatt capacity in high potential step-up and step-down transformers.

The city council of Winnipeg, Man., recently invited tenders for the installation of a system of arc lighting. The by-law having been carried by the ratepayers on April 6th, it is proposed to proceed at once with the installation of the plant. For the supply of two 100 light 2000 c.p. arc dynamos, a marble switchboard, and necessary instruments for double the number of circuits at present required, including station wiring, the tender of the Western Electric Co., of Chicago, at $5,320, has been accepted. This company will also supply 220 single carbon arc lamps for $4,532, and extra globes at $7.80 per dozen delivered. The Polson Iron Works Co., of Toronto, will furnish two compound cross condensing engines, at the price of $7,800. The tenderers for electric plant were: Western Electric Co., Chicago; Canadian General Electric Co., Toronto; Royal Electric Co., Montreal; and United Electric Co., Toronto. For engines the tenderers were: Polson Co., Toronto; Goldie & McCulloch Co., Galt; John Inglis & Sons, Toronto; and Robb Engineering Co., Amherst.

TRADE NOTES.

The Royal Electric Company are installing in the premises of the Hudsons Bay Company at Winnipeg a complete electric lighting plant.

The Montreal Island Belt Line Railway Company, of Montreal, have purchased four additional C.G.E. 1000 railway motors from the Canadian General Electric Company.

The Hamilton Brass Mfg. Company, of Hamilton, are installing in their factory, a 30 h.p. S.K.C. induction motor to drive their shafting. They are also being lit throughout by electricity.

The British Columbia Sugar Refining Company, of Vancouver, B. C., are increasing their lighting plant, and have purchased another 500 light multipolar dynamo from the Canadian General Electric Company.

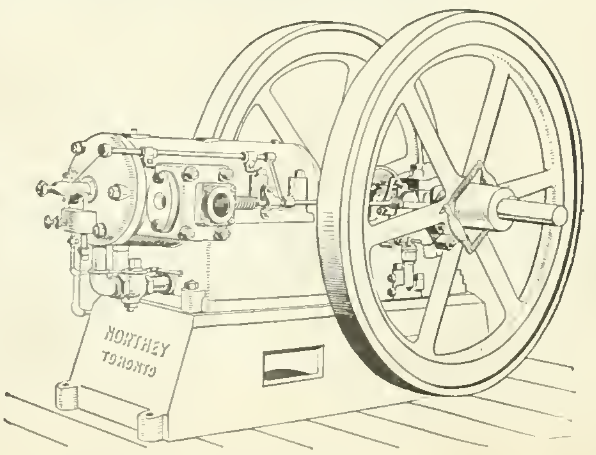
The Cataract Power Company, of Hamilton, are installing in the premises of the Norton Mfg. Company, three 15 h.p. and one 20 h.p. S.K.C. induction motors to operate the entire factory by electricity.

The Canadian Pacific Railway Company have just placed an order with the Canadian General Electric Company for one 75 h.p. induction motor, and one 75 h.p. synchronous motor which are to be used at their smelter at Trail, B. C.

The Dowswell Mfg. Co., of Hamilton, Ont., are having installed in their works one 30 h.p. two-phase motor of the Royal Electric Company's make. The current for this installation is to be taken from the Cataract Power Company's service.

The B. Greening Wire Co., of Hamilton, Ont., had installed in their works about three months ago, a 40 h.p. S.K.C. two-phase motor by the Royal Electric Co. They seceive their current from the Cataract Power Co. This has worked so satisfactorily that they have placed an additional order for one 50 h.p., one 30 h.p. and one 20 h.p. motors of the same type, to operate their entire works by electricity.

The ELECTRICAL NEWS acknowledges receipt of the annual report issued by the Engineering Society of the School of Practical Science, Toronto. Among the papers of interest to the electrical and steam engineering fraternity are the following: "Modern Systems of Interior Wiring," by L. B. Chubbuck; "Construction of the Cataract Power Company's Plant at Decew Falls," by W. Hemphill; "The High Pressure Steam Boiler," by E. Richards.



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CANADIAN
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VOL. IX. JUNE, 1899 No. 6.

WATER POWER DEVELOPMENT AT CHAMBLY.

By CHARLES W. HAAS.

AT the present time, when the development of desirable water powers and the electrical transmission and utilization of the energy thereby obtained is attracting such widespread consideration from both capitalists and manufacturers, the attention of the reader is directed to the original features and subsequent improvement of the power site at Chambly, P.Q., some eighteen miles from Montreal, on the Richelieu river. This stream, as is generally known, is the outlet of Lake Champlain. It has a strong current, and before the building of the big dam at Chambly its course near that point was broken up by a series of rapids. It was to the possibilities of development which were offered at this place that the attention of the Royal Electric Company of Montreal was directed early in 1893, when the rapid increase in their business made it apparent that more power would soon be demanded, and that unless other arrangements were made, an addition to their steam plant would be necessitated. After due consideration, therefore, they secured an option on this water power at Chambly, extending from Chambly Basin for about four miles up the river, and had preliminary plans and estimates made. These first plans contemplated developing 15,000 h.p. by building two dams and two power houses, each for 12-feet head, at a cost, exclusive of the electrical machinery, of about $80 per h.p. Vertical turbine wheels and gears and timber crib dams were proposed.

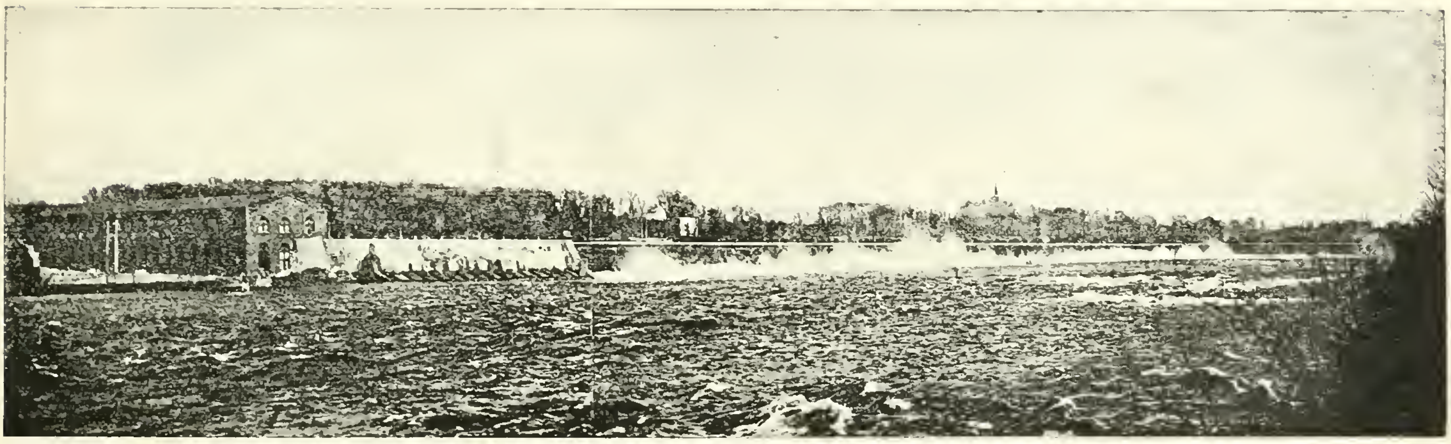


FIG. 1.—GENERAL VIEW OF THE CHAMBLY POWER PLANT.

In the spring of 1894 A. C. Rice, of Dayton, Ohio, a hydraulic engineer of wide experience, was requested to examine the proposed water power and to prepare plans and estimates for its development. He observed that the question of anchor ice (frazil) was one that demanded serious consideration in designing a plant, where, as in this case, the development of uninterrupted power was contemplated. This was the more apparent because considerable trouble from this source had been experienced by the cotton mills on the Chambly side of the river, where water power to a limited extent had been utilized for some time. The records showed that the water in the Chambly Basin had been known to rise nearly 8 feet by reason of the accumulation of anchor ice flowing down the river. Engineer Rice concluded, however, that if the power house were properly located, and the power were developed under one head of 28 feet, there would be no anchor ice to interfere with the operation of the plant; and he prepared his plans accordingly.

These plans called for one power house and one dam, the latter built of concrete; and by the use of horizontal wheels and direct connected generators, it was proposed to develop, under the head of 28 feet before mentioned, a total of 20,000 h.p., or 5,000 h.p. more than the plans of 1893, at a cost of about $28 per h.p., exclusive of the electrical machinery. In order to satisfy themselves fully regarding the most practical plan to adopt, still a third engineer was called in, that his views of the feasability of developing the power under one head of 28 feet might be obtained. The preparation of his plans and estimates consumed nearly a year's time, and, when submitted, were found to fully endorse the idea of one dam and one power house, though they called for a timber crib dam filled with stone. It was estimated, however, that the cost of the timber crib dam therein suggested would have been some $40,000 more than the concrete dam called for in the plans of Engineer Rice.

In the meantime the Chambly Manufacturing Company had been organized, the principal stockholders in it being the men who composed the Royal Electric Company. They took over the water power options which had been secured by the Royal Electric Company, and proceeded to carry out the projects of their predecessors. The plans of A. C. Rice were adopted, and in August, 1896, a contract was entered into with the Stilwell-Bierce & Smith-Vaile Company, of Dayton, Ohio, whereby they were to take the river and conditions just as they were at that time, develop the power demanded, and turn the whole plant over to the Chambly Manufacturing Company ready to run, except that they were not to furnish the electrical machinery required.

Oct. 1, 1896, work was begun on the cofferdams, and during that winter some 10,000 cubic yards of rock were excavated under the power house and in the tail race. The concrete work on the dam and power house was commenced May 1 of the following year, and on Oct. 28, 1897, upon the completion of this portion of the work, the waste gates were closed, and the water began flowing over the crest of the big dam, the length of which, including the waste gate walls, is nearly 1,900 feet. Unfortunately, at the time the water began flowing over the dam, some of the concrete was only two weeks old, and owing to the very low temperature of the water it set very slowly; so that when the ice, some two feet in thickness, went out of the pond in the spring, it did some damage to the apron of the dam, repairs to which where made after the low water in the fall of 1898.

Having in mind the highest recorded rise in the Chambly Basin due to the accumulation of frazil, the engineer located the power house about 2,000 feet further up the river, and established the tail water level about four feet above the low water level in the basin, making the wheel pits deep enough and the draft tubes long enough so that if, as he anticipated, it was demonstrated that there would be no further trouble from anchor ice after the power was developed, the tail race could be excavated four feet deeper, thereby increasing the power about 2,800 h.p. without any change in the machinery.

The forebay and wheel chambers are built in ten sections, with walls 5 feet thick between the chambers. The wheel pits are built in seventeen sections, with walls 2 feet 6 inches thick to carry the generator floor and power house, and bringing one wall directly under the centre of each generator. Through the arches and over the wheel chambers there are manholes 6 feet in diameter directly over the centre of the wheels, so that any part of the wheels can be removed from the outside of the generator room. The forebay, wheel pit walls and power house foundations are built of concrete; while the power house above the abutment and gallery floors is a steel and brick structure 75 feet wide, 308 feet long and 30 feet high from the floor to the chord of the roof trusses. The walls are 13 inches and 17 inches thick, with one course of brick outside of the steel structure. The inside of the power house walls is plastered with cement mortar, finished smooth and painted. Fig. 2 shows plan and elevations of the power house, and illustrates clearly the general arrangements.

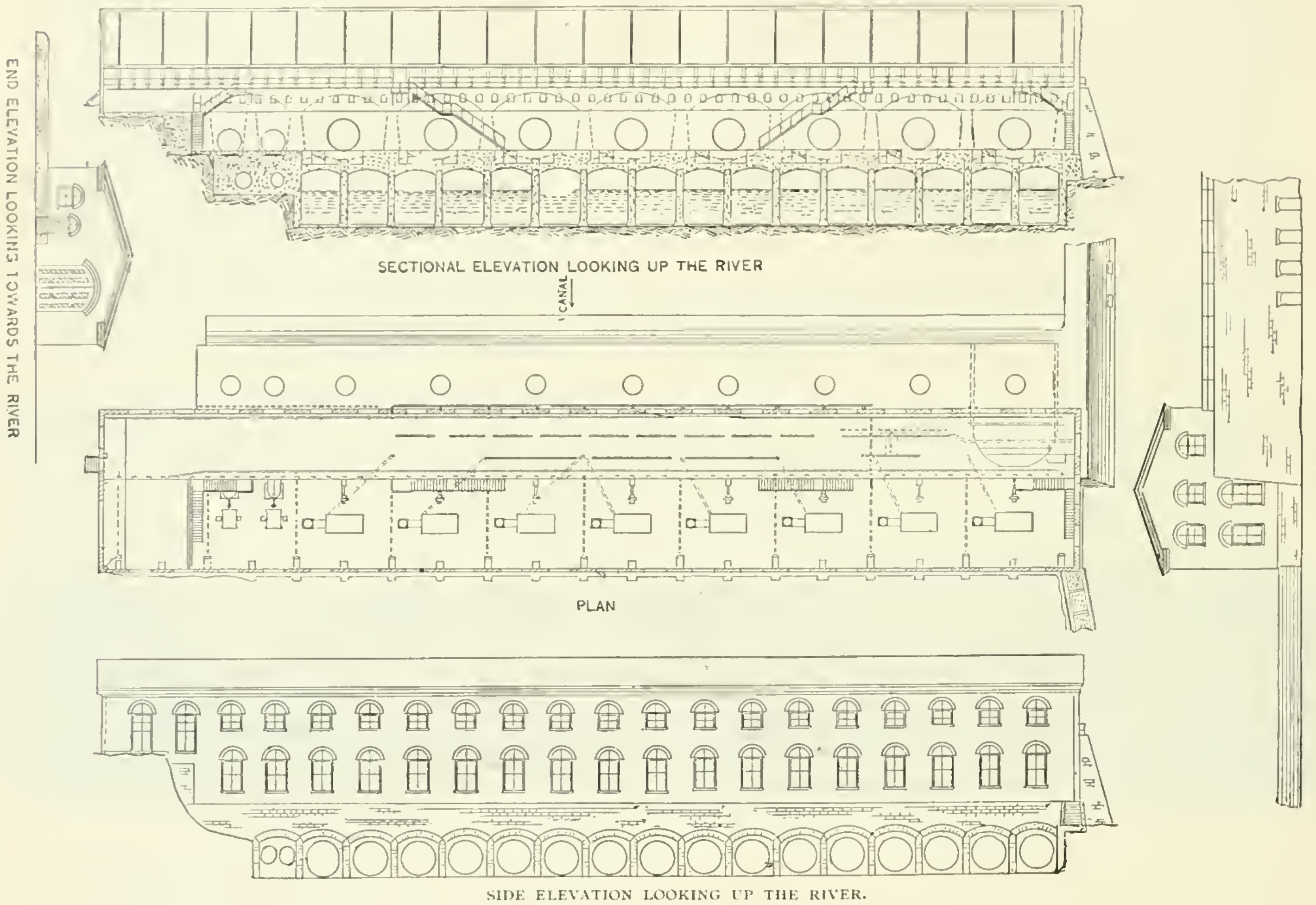

END ELEVATION LOOKING TOWARDS THE RIVER
SECTIONAL ELEVATION LOOKING UP THE RIVER
CANAL
PLAN
END ELEVATION LOOKING FROM THE RIVER
SIDE ELEVATION LOOKING UP THE RIVER.

FIG. 2.—PLAN AND ELEVATION OF POWER HOUSE.

Joining the river end of the power house and forebay walls is a waste gate abutment wall. This wall is 27 feet wide on the base, 8 feet wide at the top, and is about 33 feet high and 185 feet long. It is provided with 15 waste gates, each having an opening 4 by 6 feet.

The dam is 26 feet wide on the base, 6 feet wide at the crest, aud is 18 feet high above the apron; while the total height varies from 20 to 28 feet, with the crest 4 feet below the abutment. The overflow dam extends up the river 1,151 feet, thence across the river 550 feet, where it joins the abutment on the Chambly side. This abutment has three feeder pipes 6 feet in diameter, for supplying the cotton, woolen and grist mills of A. T. Willet & Son with power. On the rear side of the waste gate wall, around the gate openings, is a continuous southern pine timber frame, built into the wall flush with the face, to receive the gate frames. The waste gates and frames are cast iron and each gate is set on sixteen rolls, so that with the operating device on the top of the walls, two men can operate a gate under any condition of water in the river. On the top of this waste gate abutment wall is a pipe protection railing about 4 feet high, extending from the corner of the power house to the end of the abutment at the crest of the dam.

The specifications were carefully drawn up, and called for a high quality of work throughout. Some idea of the amount of labor involved may be gained from the statement that the engineer's estimates included, among other items, over 91,000 cubic yards of rock excavation, 33,763 cubic yards of concrete work, and something like 36 tons of half-inch round iron, this last-named material being built into the dam. All of the electrical work and machinery was furnished and installed by the Royal Electric Company, of Montreal. The heavy machine work was done in their shops at Montreal, the lighter work and assembling being done at the power house at Richelieu. This made the progress of this portion of the work very slow and expensive; but, as the power was to be used in the city of Montreal, and the wire line had to cross the St. Lawrence river on the new Victoria bridge, it has been impossible to deliver power in the city until the completion of the bridge. Aside from this, the disrupted ownership of a certain strip of ground lying between the city limits and the abutment of the bridge would still have made it doubtful as to just when the current could be delivered at the sub-station in Montreal, even if the bridge were finished.

The exciter wheels were first started Nov. 18, 1897, and the first power from them was delivered to a saw and grist mill at Richelieu, situated about one mile from the power house, Jan. 27, 1898. The generator wheels were started Feb. 22, and the first generator was connected to the wheels May 26, 1898.

The wisdom of developing the power under one head of 28 feet, with the idea of obviating the trouble previously experienced with frazil, was fully demonstrated during the winters of 1897-98 and 1898-99, when the cotton mills ran continuously without any trouble whatever; while at the same time the exciter wheels were operating, and the waste gates were discharging more water than the large wheels will ever use.

Twelve inches of the outside face of all the walls and the dam itself is built of concrete composed of one part best Portland cement, two parts good clean sharp sand, and five parts of broken stone that would screen two inches, while the inside portion of the dam is built of large blocks of stone excavated from the tail race and filled solid with concrete.

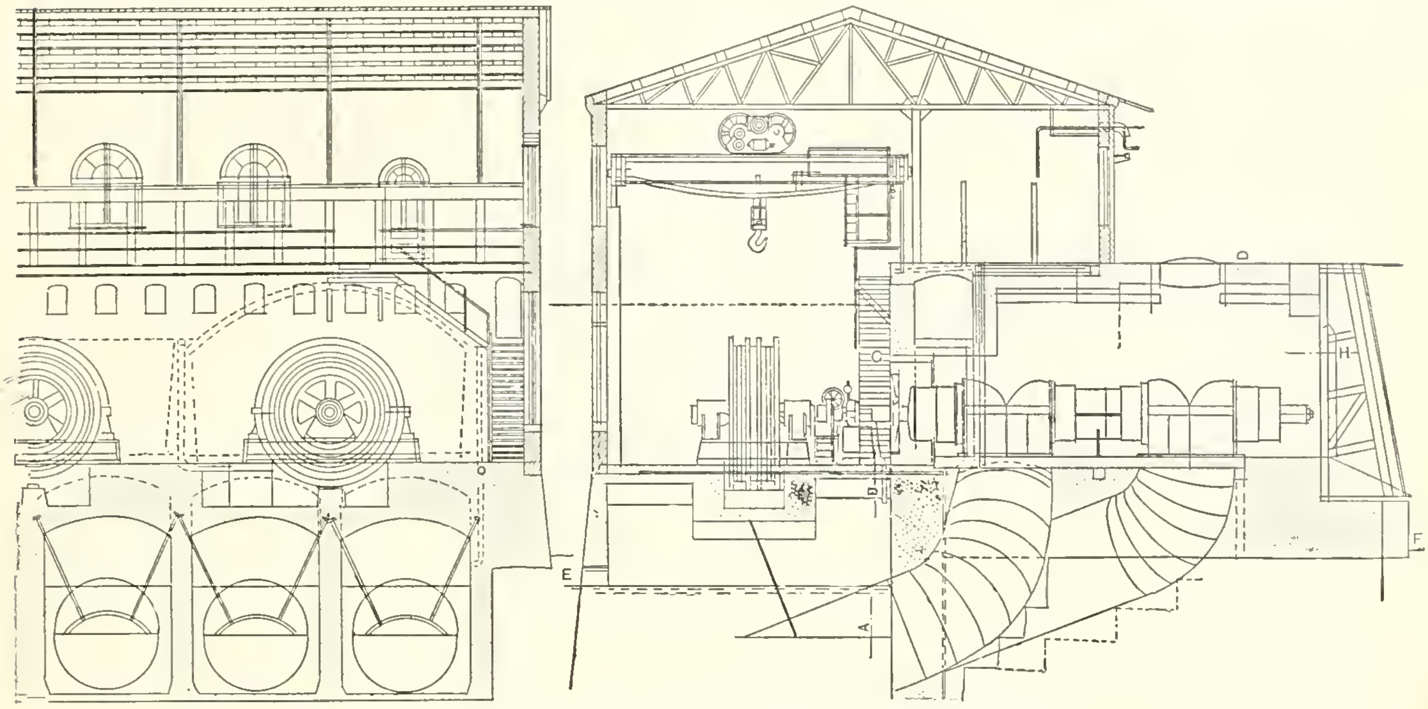


Fig. 3.—Sectional Elevations through Wheels ane Power House.

The full turbine equipment will consist of 16 pairs of 46-inch cylinder gate horizontal wheels, and two single 27-inch cylinder gate horizontal wheels; all of the "Victor" type. The 48-inch wheels are used for driving the generators, each two pairs of turbines constituting one unit, which will develop 2,648 h.p. and 153 revolutions per minute under 28-foot working head. Each unit furnishes the motive power for one of the 2,500 h.p. generators, leaving in the wheels 148 h.p. for regulation. For each two pairs of these wheels there is provided a Giesler electrical governor mounted in front of the wheel chamber, with a suitable hand wheel located near the governor and generator for operating the gates. Fig. 3 shows sectional elevation through the wheels and power house.

The 27-inch wheels, each of which develops 200 h.p. and 260 revolutions per minute under 28-foot working head, are used to drive the exciting generators. Each of these exciting generators requires 175 h.p., leaving 25 h.p. in each wheel for regulation, which is provided by a Snow mechanical governor for each, mounted in front of the wheel chamber. Sectional elevations through the exciter wheels and power house are shown in Fig. 4. At the present time both the exciter wheels are in place, and eight pairs of the generator wheels. The power house, forebay and wheel chambers are, of course, arranged for the reception of the remaining eight pairs of generator wheels as soon as the Chambly Manufacturing Company may call for them.

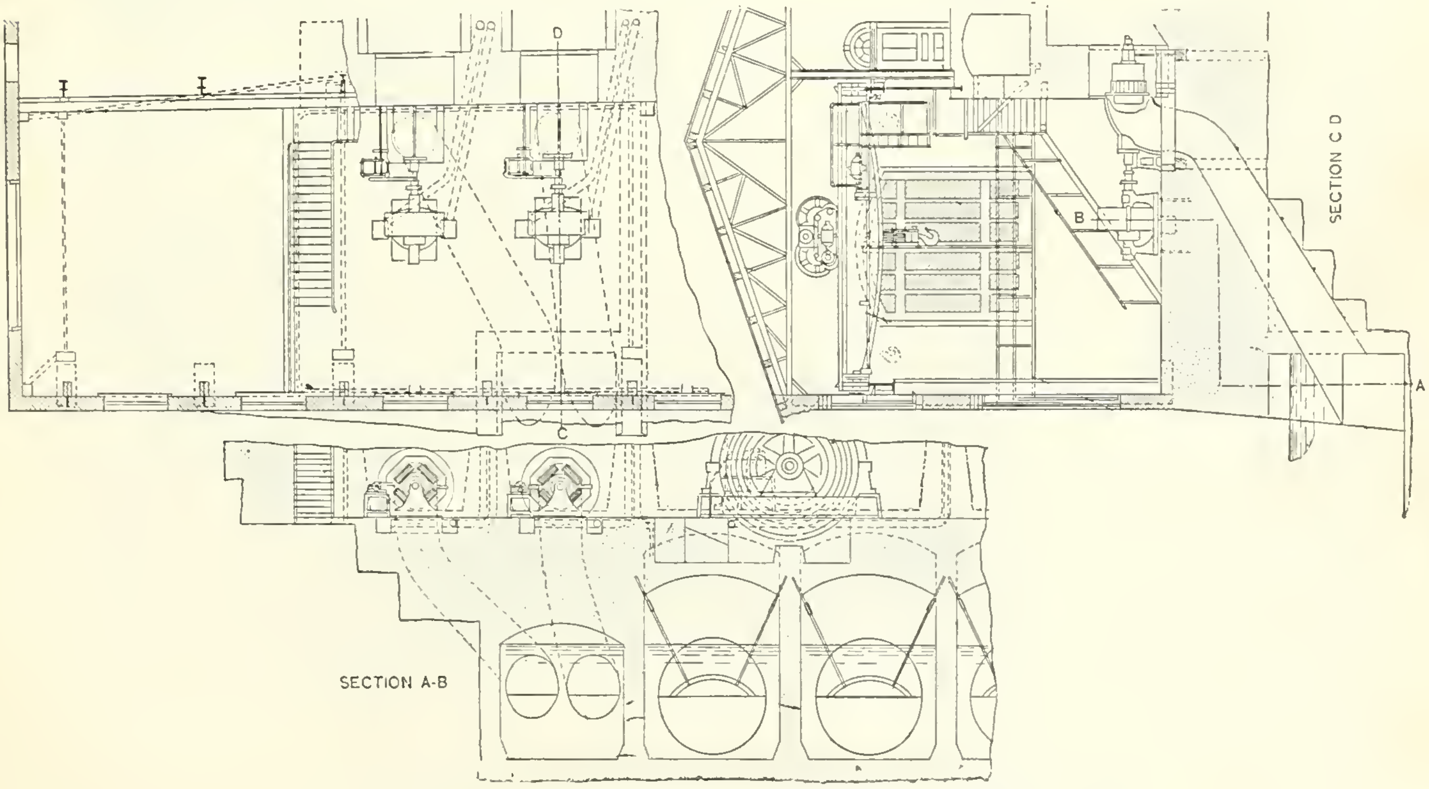


Fig. 4.—Sectional Elevations through Exciter Wheels and Power House.

Fig. 5 shows the exterior, and Fig. 6 the interior of the power house. It will be observed that it is light and roomy; the generators on one floor and the switchboards in the gallery above where the operator can have an unobstructed view of the whole generator room.

The entire plant affords an excellent example of modern engineering practice, and great credit is due both to the engineer and the builders of the powerful turbines and generators. Unusual interest has been manifested in the progress of the work by prominent engineers, and the plant has been visited by a number of the leading engineering societies.

The four sets of wheels and generators were started April 10 for a continuous trial run of thirty days, as provided for in the contract between the Chambly Manufacturing Company and the contractors for the water-power equipment. The results have been very satisfactory indeed, and a rheostat test of the generators has shown as high at 3160 h.p. output of one generator with about a 30-foot head of water on the wheels. As soon as the wire line to Montreal can be completed, the abundant supply of electrical power available will prove of immense value to the industrial interests of the city, and will mark the beginning of an era of greatly improved conditions.

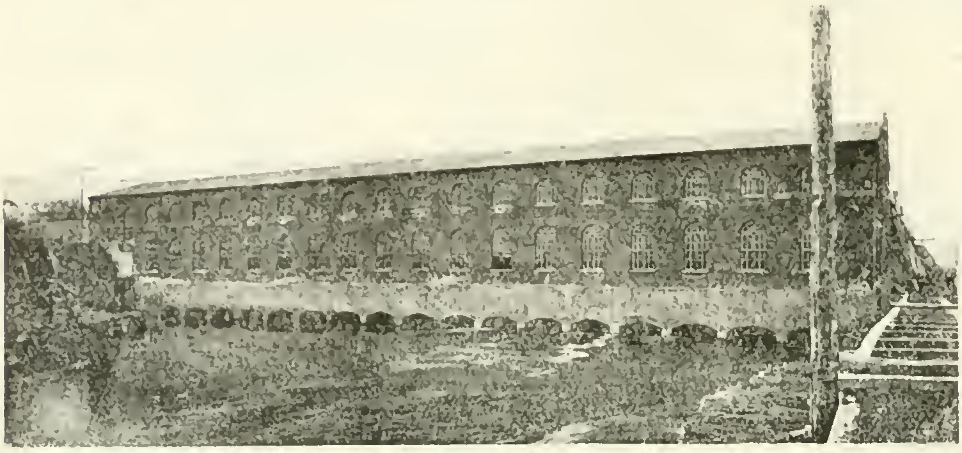


Fig. 5.—Exterior of Power House.—Chambly Power Plant.

All the iron and steel work, including the waste gates, hand rail, rack frame and rack, wheels, draft tubes, steel structural work in building, traveling crane and crane track, was furnished by the Stillwell-Bierce & Smith-Vaile Co., who contracted, as before stated, for the entire hydraulic plant; but sub-let the work of excavation and building to Peter Lyall & Sons, of Montreal.—Electrical World.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Montreal No. 1, C. A. S. E., have decided to hold a picnic and games on Saturday, July 15th, at Cartierville. This picnic is being held for the purpose of assisting the mechanical library of the association.

James Aikins, secetary of Brockville No. 15, furnishes the following list of the officers of that branch: Past president, John Grundy; president, Wm. Robinson; vice-president, Chas. L. Bertrand; recording secretary, Jas. Aikens; treasurer, W. F. Chapman; conductor, Clarence Van-Arnum; doorkeeper, Victor Hannan; trustees, Edward Devine and James McRitchie.

The City Council of Toronto have awarded the contract for electrical apparatus to be used for lighting the new city and county buildings to the Canadian General Electric Company. The plant consists of one 100 kilowatt direct connected unit, together with switchboard and instruments.

PERSONAL.

Mr. Edward Bailey, electrician for the Perth Waterworks Co., has removed to Montreal, where he has obtained a more lucrative position.

In the recent bye-election in North Waterloo, Mr. L. J. Breithaupt, president of the Berlin Gas & Electric Company, was elected to a seat in the Ontario legislature, defeating his opponent by 116 votes.

To Professor Dean Bovey, of the Faculty of Applied Science of McGill University, Montreal, belongs the distinguished honor of being elected a member of the Council of the Institute of Civil Engineers, of England.

The Electrical News learns with regret that Mr. J. Wilson, superintendent of the C. P. R. telegraphs in British Columbia, has been confined to the hospital at Nelson through serious illness. He is now, we understand, almost recovered.

Mr. Nelson Graburn, assistant superintendent of the Montreal Street Railway, has resigned his position, and will shortly go to Glasgow, Scotland, where he will become superintendent of the Glasgow Corporation tramways. Mr. Graburn, while assistant to Mr. McDonald, had charge of the electrical equipment of the company.

Mr. Wm. W. Grant, of the engineering and sales department of the Westinghouse Electric & Manufacturing Company, has been transferred from the New York office of that company to the office of the Canadian agents of the company, Messrs. Ahearn & Soper, Ottawa. The Westinghouse Company's business in Canada is assuming large proportions.

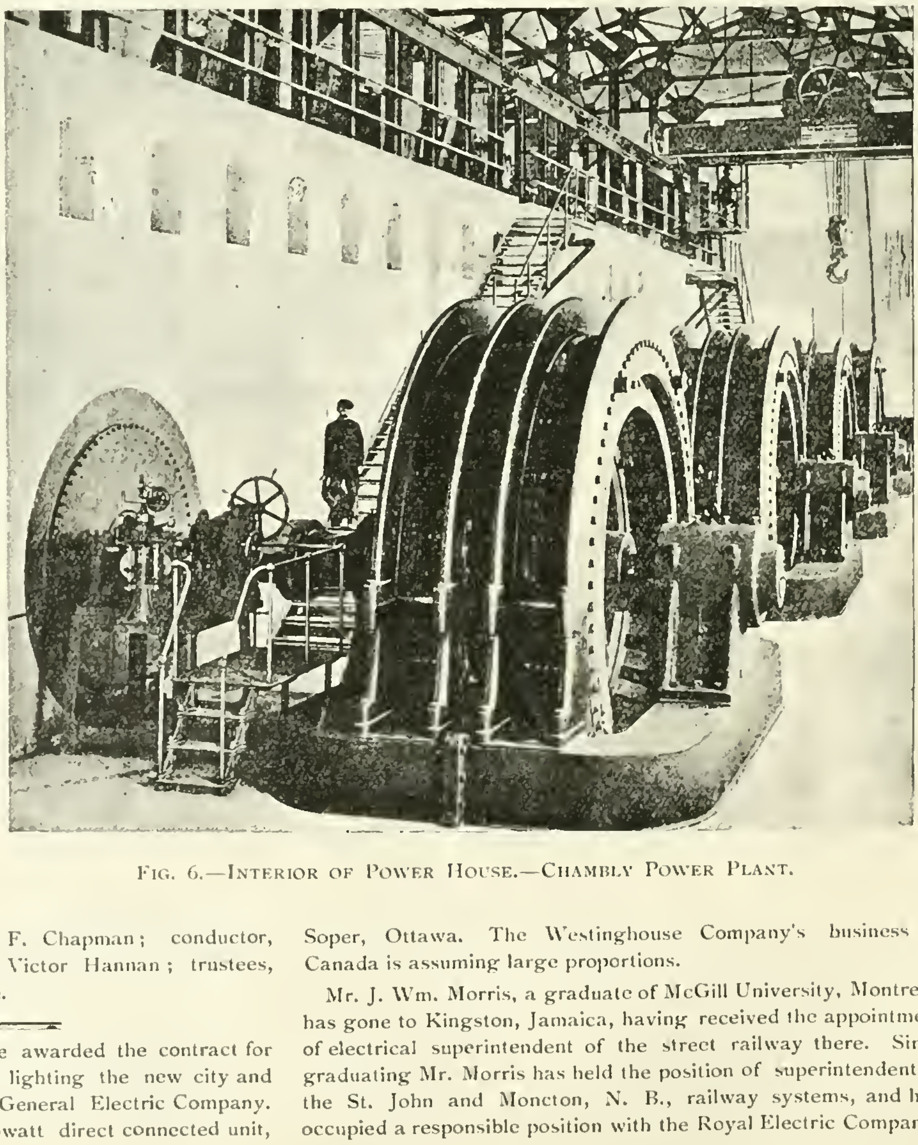
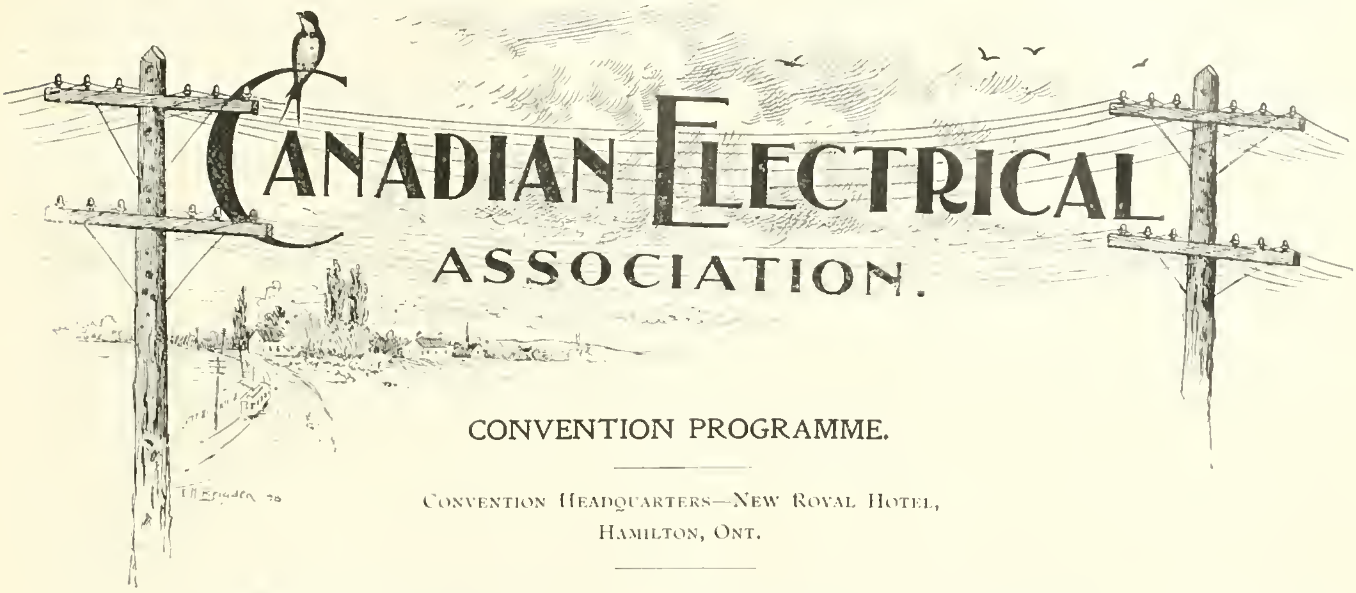


Fig. 6.—Interior of Power House.—Chambly Power Plant.

Mr. J. Wm. Morris, a graduate of McGill University, Montreal, has gone to Kingston, Jamaica, having received the appointment of electrical superintendent of the street railway there. Since graduating Mr. Morris has held the position of superintendent of the St. John and Moncton, N. B., railway systems, and has occupied a responsible position with the Royal Electric Company, of Montreal.



CANADIAN ELECTRICAL ASSOCIATION.

CONVENTION PROGRAMME.

Convention Headquarters—New Royal Hotel,
Hamilton, Ont.

BUSINESS PROGRAMME.

Wednesday, June 28th.

11.00 A.M. Meeting of Executive Committee.

2.00 P.M. Opening of first session in Convention Hall, New New Royal Hotel.
President's Address.
Reading Minutes of Last Meeting.
Secretary-Treasurer's Report.
Reports of Committees and General Business.
Presentation of Papers.
Discussion.

Thursday, June 29th.

9.30 A.M. Consideration of Reports of Committees.
Election of Standing Committees.
Selection of Place and Time of next Meeting.
General Business.
Presentation of Papers.
Discussion.

2.30 P.M. Presentation of Papers.
Discussion.

Friday, June 30th.

9.30 A.M. Election of Officers.
Unfinished Business.

LIST OF PAPERS.

"Meters and Meter Rates."	A. A. Dion, Ottawa.
"Cost of Electric Power Produced from a Steam Plant."	C. B. Hunt, London, Ont.
"Inspection": Compulsory inspection of installations; Montreal Fire Commissioners' Report as to causes of fire.	W. J. Plewes, Montreal
"Long Burning Enclosed Arc Lamps."	W. A. Turbayne, Hamilton, Ont.
"The Incandescent Lamp for Central Stations," considering efficiency, candle power, distribution of light, regulation, and whether 220 to 240 volt lamps are likely to come into general use, also a reference to the Nernst lamp.	E. E. Cary, St. Catharines, Ont.
"Central Station Accounting from a Business Standpoint."	P. H. Hart, Montreal.
"Transformer Economy."	F. H. Leonard, Jr., Montreal.

In addition to the papers, there will be a few matters for general discussion, alsn a "Question Box."

SOCIAL FEATURES.

Wednesday, June 28th.

7.30 P.M.—Trip to Burlington Beach and excursion on the Lake, returning by Hamilton Radial Railway, visiting en route the power stations of the Hamilton Street Railway Company and the Hamilton Radial Railway Company.

Thursday, June 29th.

5.00 P.M. Trip to Grimsby over the Hamilton, Grimsby and Beamsville Electric Railway, and on return, visit to the Hamilton Electric Light & Power Company's power station

9.00 P.M.—Annual Association Banquet, New Royal Hotel.

Friday, June 30th.

12.30 P.M.—Take train on Grand Trunk Railway for visit of inspection to the Cataract Power Company's works at DeCew Falls; leaving for Hamilton and points east and west at 5.31 p.m.

ACCOMPANYING the programme of the forthcoming annual convention of the Canadian Electrical Association, printed above, will be found in succeeding pages, particulars and illustrations of some of the electrical and other features of interest in and about the city of Hamilton, where the event will take place.

Convention Headquarters—New Royal Hotel, Hamilton.

Some of our readers will recollect that the first convention of the Association, following soon after its organization, took place in Hamilton. The success then achieved was such that the promoters felt encouraged to go forward, and the subsequent history of the Association has been one of steady development. In the proceedings of the first convention held June 14th, 15th and 16th, 1892, are recorded the names of several gentlemen who are still members of the various committees of the Association, and are regarded as being among the most active and successful promoters of its welfare. There should be a reunion of all these at the coming meeting, in addition to an attendance of the majority of those whose membership dates from a later period. Not only so, but it may reasonably be expected that electric lighting companies throughout the province will mark their appreciation of the value of the Association's recent efforts to conserve the rights of the electric lighting industry, by submitting their names for membership at or previous to this meeting.

From an electrical point of view, especially, Hamilton has made wonderful progress since the time when the first convention of the Association met there. Ottawa and Montreal were then the only important electrical centers in Canada. Recent developments have placed in the same rank, Hamilton, Quebec and other cities.

The enterprise of the citizens of Hamilton in this direction is seen in the numerous electric railway systems which now radiate from that centre. By the construction of these railways Hamilton has attracted to itself the trade of a large and prosperous territory, and has thereby greatly increased its commercial importance and prosperity. The Cataract Power Co. represents the greatest and boldest enterprise of the citizens of Hamilton in this direction. By successfully providing for the generation and transmission of at least 8,000 horse power of electrical energy, from a water power situated near St. Catharines, they have, so to speak, taken the wind out of the sails of the electric power companies at Niagara Falls, so far as the market for power between St. Catharines and Toronto is concerned. Having got their plant in successful operation, the question of finding a market for all the power which can be developed at their works is understood to be now engaging the attention of the management, and it need cause no surprise if before or shortly following the convention, the rumored consolidation under one management of all the electric light and railway companies having their headquarters in Hamilton, should become an accomplished fact. These electrical developments, combined with the numerous other features of interest set forth by the programme, together with the attractiveness of the city itself, and its central location and accessability by rail and water, should ensure for the coming convention a large attendance and a full measure of success.

City Hall, Hamilton, Ont.

The local committee having charge of the convention arrangements is as follows: Messrs. George Black, superintendent G. N. W. Telegraph Company, chairman; Mark Thomas, manager Hamilton and Dundas Railway; H. R. Leyden, manager Cataract Power Company; Gordon J. Henderson, manager Hamilton Electric Light & Power Company; A. J. Nelles, manager Hamilton, Grimsby & Beamsville Railway; Wilfred Phillips, manager Niagara Falls Park & River Railway; A. B. Smith, G.N.W. Telegraph Co.; E. E. Cary, manager Packard Electric Company; J. B. Griffith, manager Hamilton Street Railway; C. K. Green, manager Hamilton Radial Railway.

THE ELECTRIC RAILWAY SYSTEMS.

The Hamilton Street Railway was the first in Canada to be operated enitrely by electricity, the old horse car system being converted to electric power in the year 1892. This system, operating within the city limits, comprises 11 miles of double track. The equipment consists of 35 motor cars, built by Jones, of Troy, N. Y., and 15 trailers. The electrical equipment is Westinghouse excepting one equipment of G. E. 1,200, which is used on a water car for sprinkling the streets, this being done under special contract with the city. The road extends to Dundurn Park, owned by Senator McInnes, which is one of the finest in the Dominion, and also connects with two inclines, one at the head of James street and one at the head of Wentworth street. The power house of the Hamilton Street Railway Co. is a brick and stone structure situated at the foot of Hughson street, on the shore of Hamilton Bay. The motive power consists of wheelock tandem compound condensing engines, six boilers and Westinghouse dynamos. The officers of the company are as follows: President, Edward Martin, Q. C.; vice-president, John A. Bruce; secretary-treasurer and manager, J. B. Griffith; electrician, V. H. Waggoner.

Besides the Hamilton Street Railway, the city is fast becoming the centre of a magnificent system of radial railways. The longest road is the Hamilton, Grimsby and Beamsville electric railway, which travels east to Grimsby and Beamsville, a distance of 24 miles, passing through a country that for years has been known as the fruit garden of Canada. The power house, a brick and stone structure, is situated at Stoney Creek, about midway between the two terminals of the road. The generating plant consists of two Westinghouse dynamos, 300 h.p. capacity in engines, and two 200 h.p. in tubular boilers. The cars consist of nine motor cars and five trailers. Mr. A. J. Nelles is secretary and manager of the road, and Mr. C. Fraser chief electrician.

The Hamilton Radial electric railway leaves the city by the north-east, skirting the bay shore until the beach is reached, then crossing the beach and passing between handsome villa residences to the village of Burlington, ten miles from the city of Hamilton. Two C. G. E. generators of 400 k. w., 500 h.p. in engines, and 300 h.p. in boilers, comprise the equipment of the power house, which is located at Burlington. Six motor cars and two trailers are operated. Mr. C. K. Green is manager and Mr. C. G. French chief electrician.

In the year 1896 the Hamilton and Dundas railway, then operated by steam, was converted to an electric spstem. It extends from Hamilton to Dundas, about 5 miles to the west. Mr. Mark B. Thomas is manager of the road and Mr. P. McCullough chief electrician.

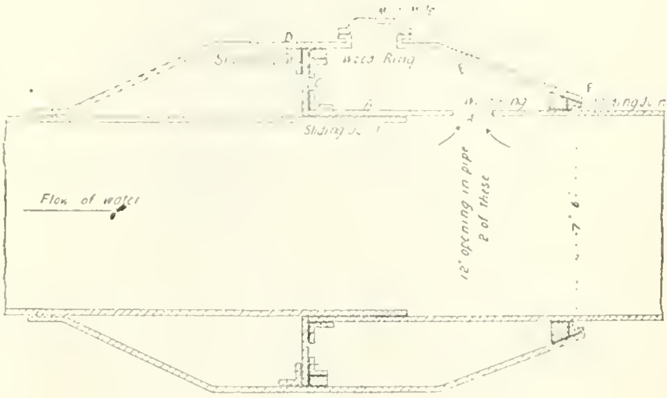
THE CATARACT POWER COMPANY.

The magnificent enterprise of the Cataract Power Company has already been described in the ELECTRICAL NEWS. Power is generated near St. Catharines, Ont., and transmitted, at a pressure of 24,000 volts, to the city of Hamilton, a distance of 35 miles. In a paper by Mr. Wm. Hemphill, read before the Engineering Science of the School of Practical Science, Toronto, we find the following additional particulars regarding the construction of the steel pipe that carries the water from the reservoir at the edge of the mountain to the wheels in the power house: The pipe is 735 feet long, 8 feet 6 inches in diameter at the top, and 7 feet 6 inches at the bottom; it is ¼-inch thick at the top and gradually increases to a thickness of 13-16-inch at the bottom, both tranverse and longitudinal seams being double riveted. This pipe is large enough to supply 6,000 h.p. At the top of the mountain, the stone was dug out to a depth of 8 or 10 feet, the pipe laid in this, and securely fastened by concrete in the mason work, heavy flanges having first been riveted to the pipe. The flanges were necessary as a great part of the weight of the pipe is supported at the top. At the upper end of the pipe, suitable grates are placed, to keep out ice and drift wood. As the current in the canal is very slow, there is not much danger arising from drift ice. At distances of 15 feet down the side of the mountain solid blocks of mason work are built for the pipe to rest on.

COURT HOUSE, HAMILTON, ONT.

About two-thirds of the way down the side there is a ledge on the mountain about 60 feet wide, the pipe follows this, and then runs down at an angle of 20° to the power house, where it turns almost at right angles, and passes under the power house. Near the edge of the ledge in the mountain there is an expansion joint, to take up any elongation or contraction that may occur in the pipe. This joint is constructed so that it supports the remainder of the weight of the pipe. The joint, being larger than the pipe, rests in a hollowed-out portion of the mason work, making it very secure.

The illustration shows a longitudinal cross-section of this expansion joint. At B is shown how two sections of the pipe slide, one inside the other, with a piston and cylinder action, forming a sliding joint. At C is shown an iron ring, fastened with angle iron as shown, and this forms a sliding joint at D. At A is a 12-inch opening in the pipe, through which the water can flow. There are two of these holes. The water fills this portion of the joint, and the pressure of the water against C has a tendency to keep the lower part of the pipe in place. The water presses against E, causing a little spring in the joint. The combined action of the spring in the iron and the pressure of the water against C takes up any elongation or contraction that may occur. It was found necessary to pack the joints with wooden rings, as shown, some six or seven inches thick, and when the wood swelled, it stopped the leakage to a large extent, but this swelling of the wood will not allow the joint to move much. As F is an iron ring around the pipe, this ring is flanged and riveted to part E, as shown, forming another sliding joint.



CROSS-SECTION OF EXPANSION JOINT IN PIPE.—CATARACT POWER COMPANY.

THE HAMILTON ELECTRIC LIGHT & POWER COMPANY.

Situated on Main street is the dynamo room of the Hamilton Electric Light & Power Co., its dimensions being 135 x 70 feet. The machines consist of arc and incandescent lighters and electric power generators. There are two Royal alternators with exciters, one C.G.E. 2,000 lighter, and one Westinghouse 1,800 lighter. Fifteen machines of varying power are for the supply of arc lights, fourteen being from the Royal Electric Co. There are two pair of Brown engines of 700 h.p. each. On King street is a three-storey structure in front, combining the offices of the company and several other offices. The rear is taken up by the boiler room, where there are three batteries, one consisting of five 60-inch Osborne-Killey tubulars of 75 h.p. each, the second of two 66-inch Goldie & McCulloch tubulars of 90 h.p. each, and the third of two Polson water tubulars of 200 h.p. each. This company now hold the contract for lighting the streets of Hamil-

Mr. E. E. Cary.

Mr. Mark B. Thomas.

Mr. H. R. Leyden.

Mr. Geo. Black, Chairman.

Mr. A. B. Smith.

Mr. C. K. Green.

Mr. A. J. Nelles.

Mr. Gordon J. Henderson.

SOME MEMBERS OF THE LOCAL COMMITTEE—CANADIAN ELECTRICAL ASSOCIATION CONVENTION, HAMILTON, 1899.

ton. Recently the management decided to take power from the Cataract Power Co.'s system, instead of generating it themselves. Mr. Gordon J. Henderson is manager of the Hamilton Electric Light & Power Co., and Mr. T. W. Martin chief electrician.

G. N. W. TELEGRAPH OFFICE.

About 2 o'clock a. m. on the morning of May 19th, 1898, during a severe thunderstorm and downpour of rain, the office of the Great North-Western Telegraph Company in Hamilton, along with the building in which it was situated, was destroyed by fire. So complete was the destruction that not an instrument or even a printed message blank was saved out of the wreck—the books (the current month's business), a portion of the lower office furniture, and some battery cells only being rescued. As early as possible the chief operator and the linemen cut all the wires through, so that by the time of opening for business at 8 a.m. all through circuits were completed, and no stoppage of business except with Hamilton ensued. The only wires incommoded temporarily were those depending upon Hamilton batteries, which were demolished in the basement of the burnt building. The manager in the meantime had secured the only vacant premises in the neighborhood, and at 7 a.m. began moving in the few articles saved

The new location was about 60 yards south of the old office, and as no poles could be erected, a 50 wire cable was secured for temporary use ; instrument tables, battery stands, etc., had to be made out of pine boards. The first supplies arrived from Toronto by the 8 o'clock train, wires were rapidly got working, and before dark all necessary circuits were connected with the office. Those not required for local purposes were left cut through in the cable box ; about one hundred wires were in the mix, but few offices were aware that anything unusual had occurred. The temporary quarters being too small, the adjoining office with No. 34 was secured and fitted up for permanent quarters. The premises are 18 by 61 feet, all on the ground floor; front consists of a large plate glass window, and door on each side. The counter running across the office is made of ash, with cherry top, covered with plate glass, a neat brass screen dividing it lengthways, with openings to receive messages through. Inside are the necessary desks, etc., for clerk and manager, and below these desks is the operating department. The switch case and instrument tables are of ash and cherry. The tables provide space for 21 instruments, three sets of repeaters, and space for extension. The switch is Bunnell's latest design, with space for 70 wires. The office presents a neat and handsome appearance, windows at back and front giving perfect light and ventilation, metallic ceiling of neat pattern and light color, walls covered with grey ingrain paper, with 18 feet ceiling.

The wires are led into the office in two 50 wire and one 18 wire Kerite cables, boxed in, and back of switch case opens into a distributing box. This box and its surroundings are covered with asbestos board, and every precaution possible has been taken to avoid fire from electric contacts after leaving the box each wire passes through covered porcelain fuse blocks, which are separated from each other by glass strips, then recabled to the switch-board, and from the switchboard cabled to each instrument table. All wires not in cables are Kerite covered. The sounders are in resonator boxes of neat design, and everything arranged for prompt and efficient handling of business with perfect ease.

The office is admired by all who have seen it. One gentleman connected with the telegraph service who has visited all the principal offices in the United States and Canada, says it is one of the neatest he has came across.

Although the old office took fire during a thunderstorm, there is nothing to connect the fire with lightning coming in on the wires. All reliable evidence indicates that the fire started in the south part of the building, and rapidly spread to the north end. The telegraph operating room floor was not touched, and the business office damaged by water and fire entering from behind. The office is under the management of Mr. George Black. Members of the Canadian Electrical Association are invited to visit the office during their stay in Hamilton.

POST OFFICE, HAMILTON, ONT.

THE BELL TELEPHONE EXCHANGE.

The Hamilton exchange of the Bell Telephone Company is quite important, inasmuch as it is the central distributing point for long distance messages to the United States and elsewhere. The exchange is under the management of Mr. B. J. Throop, while Mr. H. C. Baker, manager for Ontario, also makes his headquarters in Hamilton. The company intend to lay a number of underground conduits in the city this summer.

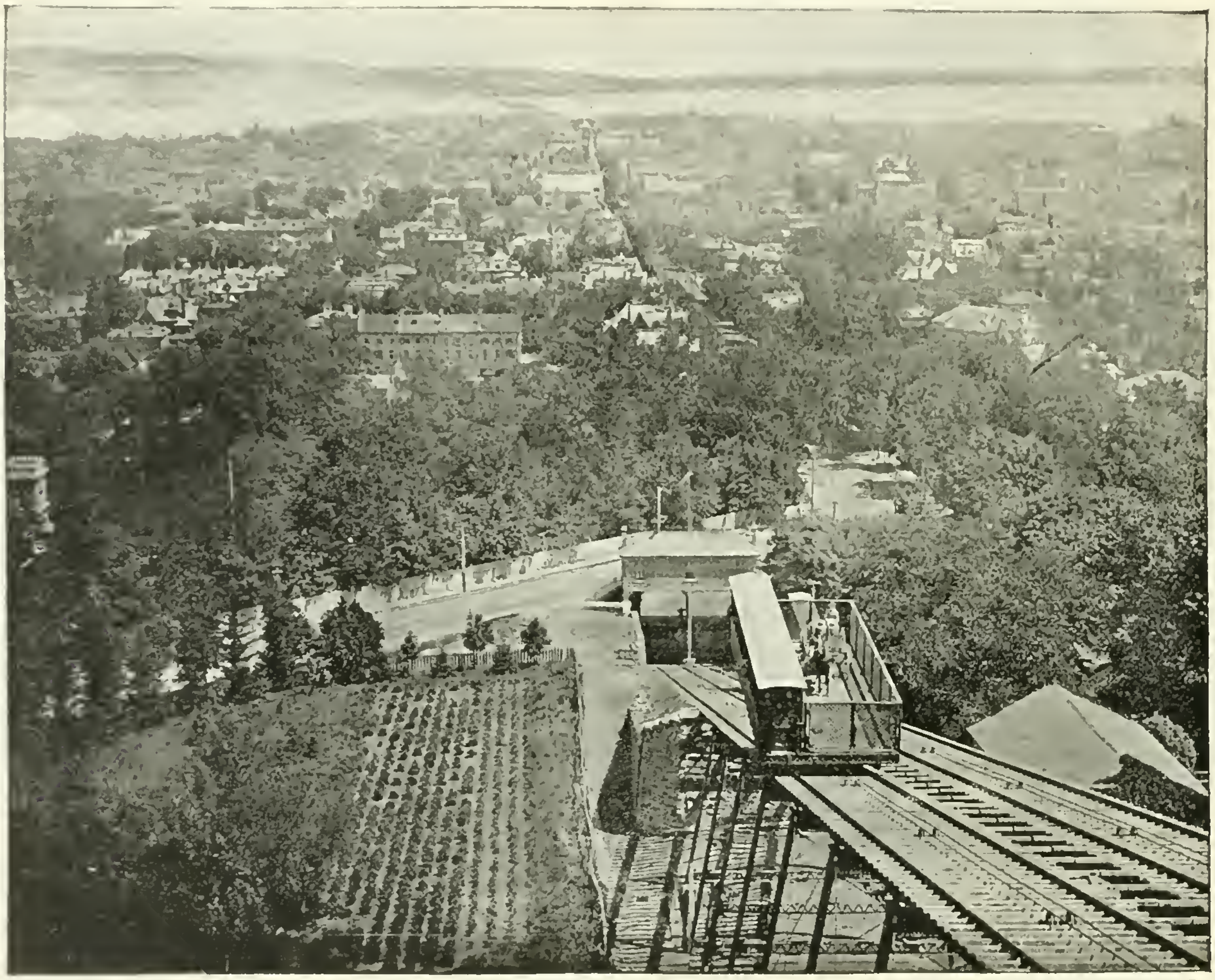
HAMILTON AND BARTON INCLINE RAILWAY.

IT is well known that along the south side of the city of Hamilton, and extending for miles in either direction, stretches a bold, steep escarpment, known as the Hamilton mountain. This mountain is from two hundred to four hundred feet higher than the level of the city, and to provide means of access for wagons, electric cars, etc., the Hamilton and Barton incline railway, a view of which is here shown, was constructed in the year 1892. It is a straight cable road of uniform grade, extending from a point at the commencement of the rapidly rising ground to the top of the escarpment. The distance between these two points is 700 feet, and the rise 195 feet. The central portion of the track is at an elevation of about 50 feet above the surface of the ground.

The road has a double track. The lower portion of the road-bed is built upon the ground, partly through a cutting and partly upon an embankment formed by the material taken from the cut. The road-bed at the lower end commences in a pit 13 feet deep—that is, 13 feet below the level of the approach to the track. This pit is formed to receive the peculiar-shaped cars of the road, which are built with level platforms and consequently, to suit the steep grade, which is 30.7 per cent., require to be 13 feet high at the one end, the other being as close to the track as possible.

The cutting within a very short distance attains a depth of thirty feet, the width of road-bed being 34 feet. The upper end of the embankment is terminated by a heavy stone abutment, built to receive the lower ends of four girders forming part of a steel trestle viaduct. This abutment is built with large, heavy stone, and provided with wing walls turning back to meet the retaining walls, or rather the retaining walls are extensions of the wings.

The steel trestle extends over about two-thirds of the length of the railway, and consists of eleven 30-feet spans and one of 37 feet. Most of the bents, which are of steel, supported by two stone piers or pedestals, are from 30 to 50 feet in height. They carry four parallel track girders two feet in depth and spread eight feet from centre to centre. The whole structure is designed so that a moving load of 60,000 pounds will not produce a greater strain than 10,000 pounds per square inch of section on any member. Across each pair of these inclined girders the ties are placed, and upon them, directly over the centre of the girders, the track rails, which are bolted to the girders. There are then two parallel tracks eight feet from centre to centre of rails and eight feet apart. Upon the bank, below the trestle, the tracks are laid in the ordinary way, except that the ties are supported on the lower side by stout stakes to prevent them from working down hill.



THE HAMILTON AND BARTON INCLINE RAILWAY.

On either track runs a car 36 feet in length by 14 feet in breadth. The cars are constructed with level platforms, being supported by wedge-shaped frameworks, which raise the platforms towards the lower end about 13 feet above the tracks. The cars are combination affairs, being arranged to carry passengers and teams at the same time.

Attached to two heavy timbers, braced by heavy iron knees, in the lower framework of each car, are two steel wire cables, each having a tensile strength of 125,000 pounds by actual test. From the car the cables are carried up the centre of the tracks on small carrier wheels 14 inches in diameter.

At the head of the plane the cables pass over large cast iron sheave wheels 10 feet in diameter, these being strongly supported by iron girders and columns. Thence the draught cable passes down to a winding drum 10 feet in diameter, about 30 feet below, situated in the basement of the depot at the head of the plane; but the safety cable passes from the sheave wheels onto another large cast iron wheel of about equal size, which is set in a heavy iron framework and securely anchored to the solid rock, so that in case of the possibility of an accident happening to the draught cable the cars would be held securely by the safety. Powerful brakes are atttached to either side of the drum and to the safety wheel, and these may be applied by the engineer from the pilot house. The foundations of the drum, which itself weighs about 10 tons, are strongly anchored down to the solid rock by 16 two-inch iron bolts. The drum is controlled, and from it the road operated, by a pair of Wheelock engines of about 125 indicated horse-power.

The depot, situated at the head of the plane, and which contains all the machinery, is a four-storey stone and brick building. The basement is occupied by the engines and drum, the boilers and fuel room, and also contains a large room to be used as a workshop. The second and third flats are designed to be used as a dwelling for the engineer and his family, and the upper flat, which is only on a level with the top of the hill, contains the driving platform, a waiting room, a board room, and a large covered balcony looking out over the city. In the centre of the driving platform and opposite the centre of the tracks is situated the little 4 × 8 feet pilot house. This is built with large glass windows on all sides and commands a view of the whole road. Within it stands the engineer, who has within arm's reach the means of controlling every part of the machinery.

At the lower end of the plane there is another small but neat brick depot, and dwelling above it for a caretaker. The entrance to this depot is guarded by sliding gates, which are opened when a car is down. Into the face of the car pit are built four large iron air buffers two for each car to strike against. These consist simply of 18-inch iron cylinders provided with pistons which are drawn out by wire sash-cords hung with weights and working over pulleys.

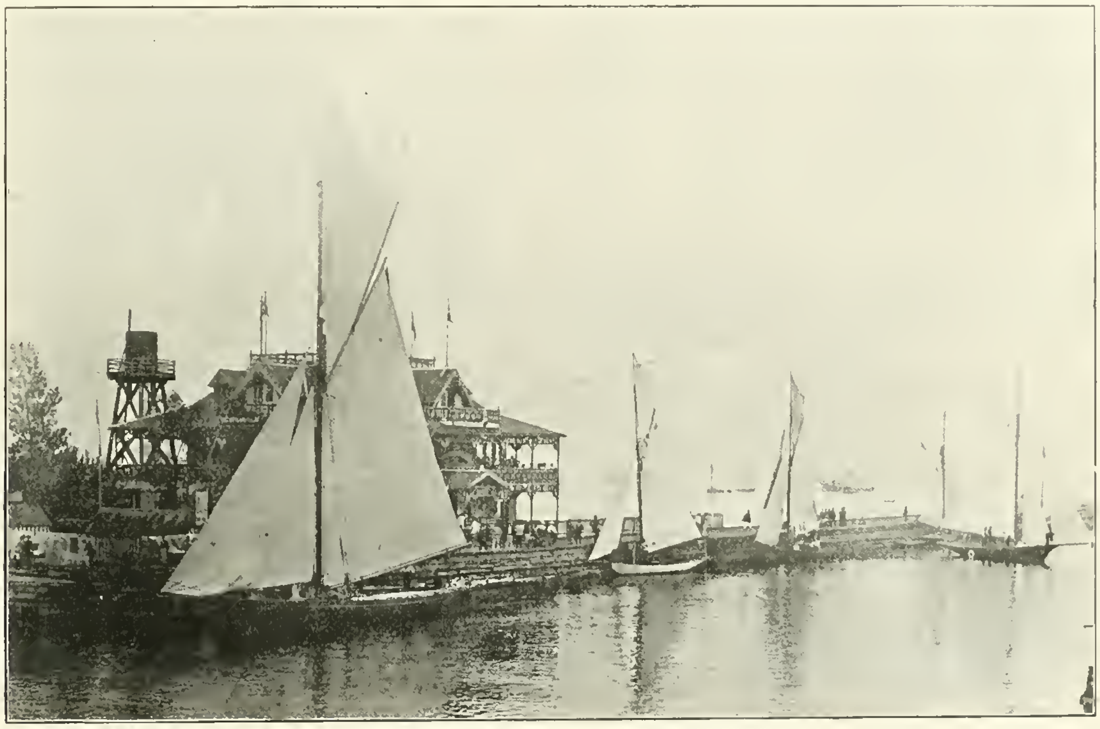
FEATURES OF INTEREST.

The Hamilton water works is owned by the city, the pumping station and filtering basins being at the Beach.

There are nine city parks in Hamilton, containing in all 52 acres. A view of the Gore Park will be found on another page.

Three fire stations are located in the central portion of the city, and four others in the outlying districts. Alarms are sent through a system of electric boxes, and also through the Gamewell police call system.

Anthority has been given the Hamilton Electric Light and Power Co., by the city council, to illuminate with incandescent lamps during the C. E. A. convention the Court House and Post-office buildings as well as the central park known as the Gore.



Royal Canadian Yacht Club, Hamilton.

Places of interest in and around Hamilton include the following: Burlington Beach, Gore, City Hall, Gore Park, Post Office, Court House, Ontario Normal School and Collegiate Institute, City Hospital, and Royal Canadian Yacht Club, an illustration of which appears elsewhere.

Hamilton possesses two hundred and twenty-seven manufacturing establishments, equipped with modern machinery and the latest labor-saving devices, and many of them, including the extensive works of the Gurney-Tilden Company, operated electrically by motors supplied by current by the Cataract Power Company.

The Hamilton Light and Power Company have had made of galvanized iron letters two feet in height the name of the company. A number of incandescent lamps inserted in sockets in holes in each letter will illuminate the sign and enable every passer by to read it. This sign will be put in position and illuminated during the Canadian Electrical Association convention, and on special occasions afterwards.

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AND
ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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The Demand for Electrical Machinery in South Africa. SOME of the American electrical journals have lately referred to the fact that that during the last fiscal year $50,000 worth of electrical machinery from the United States was sold in Cape Town. Some American manufacturing firms have established resident representatives there, by which means they are regularly kept informed regarding trade demands. The suggestion is now made that the National Association of Manufacturers should establish in Cape Town a warehouse for the display of American goods, as has already been done at Caracas, South America. These pointers as to the doings of our American neighbors should be suggestive and useful to Canadian manufacturers.

Standardizing Direct-Connected Generating Machinery. AT the recent meeting in Washington, D.C., of the American Society of Mechanical Engineers, Mr. J. B. Stanwood, of Cincinnati, presented a paper on "Standards for Direct-Connected Generating Sets." The author defined as the features that need standardization: A series of capacities and speeds, for the use of the outside engineer, and those parts of the engine and generator which have to be connected or fastened together to be standardized for each different set, to facilitate the assembling of the combined machine or "set." As the result of this paper and the discussion thereupon, a committee of the Society was appointed to co-operate with a committee from the American Institute of Electrical Engineers to consider the subject and formulate a method of standardization.

Dangers of Calcium Carbide. PREPARATIONS have been made to establish two factories for the manufacture of calcium carbide within the limits of the city of Ottawa. This has elicited a protest from the Canadian Fire Underwriters' Association, on the ground that such manufactures should be classed with those of explosives, and therefore prohibited, except in isolated and remote buildings. In a letter to the City Clerk, Mr. Hadrill, Secretary to the Underwriters' Association, points out that the English government has taken action in this direction, owing to the hazard from the finished article. Supposing that the manufactured carbide be not stored on the premises, a large amount of it must necessarily be on hand, as the pigs of carbide take many hours to cool. Regarding the contention that water thrown upon carbide when hot will not generate gas but throw the water off in steam, Mr. Hadrill argues that the surface of the carbide pigs would soon become cooled, and gas generated which water would be powerless to extinguish; in fact, the more water poured on the worse would be the fire.

New Field For Central Stations. It seems reasonably certain that in the near future the automobile carriage industry will become established on a commercial basis. Of the various kinds of motive power for these carriages, electricity gives promise of being most generally adopted. This almost certain increase in the number of electrical vehicles is likely to result beneficially to the central stations, the charging of the batteries providing a market for current during the day when there is usually a light load on the machines. In the larger cities, where a number of such vehicles would be used, an approximately constant day load could be carried. This question has already received some attention in the United States, a paper on the subject having recently been presented before the Northwestern Electrical Association by Mr. H. M. Maxim, who sees in the advent of the electric carriage a great advantage to the central station. While automobiles have as yet been introduced only in one or two Canadian cities, it is quite probable that they will become more generally used in the near future, although to what extent is uncertain. The large amount of asphalt and other smooth pavements now being constructed in our cities should encourage the use of electric carriages, as the best storage battery must become impaired by constant jolting over rough roads.

The National Electric Light Association.

The annual convention of tne National Electric Light Association of the United States, held in New York last month, is declared to have been the most largely attended and in many other respects the most successful in the history of that organization. The president in opening the convention gave some statistics showing the wonderful development of the electrical industry within the boundaries of Greater New York. He said: "Within its limits are located thirty-five electric light stations, which furnish more than 1,000,000 incandescent lights, more than 30,000 arc lights, and at least 30,000 h.p. in electric motors. The capital invested for carrying on this great business is nearly $100,000,000. It may interest you to know that in 1897, in the City of Brooklyn alone, there were ten street railway companies having 678 miles of track, and a capitalization of $55,000,000. In that year these railway companies carried 223,180,504 people. To-day, every transit company in the borough of Brooklyn is equipped or about to be equipped with electricity as its motive power, and the capitalization is $150,000,000, and 236,680,010 people were carried by this vast system in 1898. Electricity, together with the inventive genius of honored members of this association, has made this wonderful change possible." A number of excellent papers were presented and discussed. A lecture on liquified air by Mr. Chas. E. Trepler, whose recent experiments have become so widely known; an automobile excursion to Grant's Tomb; and a visit to the General Electric Company's works at Schnectedy, were prominent and highly appreciated features of the occasion. General S. T. Carnes, of Memphis, Tenn., was chosen as president of the association for the ensuing year. It is probable that the next convention will take place in New York or Chicago.

Methods of Generating and Supplying Electricity.

It would appear as though changes are likely to occur in some localities at least in methods of supply of electricity for light and power. In all the provinces of the Dominion, with perhaps the exception of Nova Scotia, New Brunswick and Prince Edward Island, steam users are obliged to import coal from Pennsylvania. In consequence of this fact, their fuel bill becomes one of the most serious items of operating expense. Owners and operators of works for the supply of electricity doubtless realize to the fullest extent the truth of this statement. There is no more important question to them than that of how to keep down the fuel account. The keenness of competition and other causes have in many instances reduced prices for current to unprofitable figures. In the majority of cases any attempt to increase them would probably not be successful, but, on the contrary, would be certain to lead to a disturbance of conditions which have come to be regarded, by the consumer at least, as being permanent, and would in consequence arouse antagonism to the companies. The latter must therefore adopt the alternative plan of trying to lessen, to the greatest extent possible, the cost of generating the current, while at the same time, by the use of the most improved apparatus and the best arrangement of circuits, ensuring the profitable utilization of as high a percentage of the current generated as may be possible. Naturally enough, under such conditions, the attempt is being made to cheapen production by substituting water power for steam wherever by this means a saving can be effected. The relative efficiency and economy of the two methods is one of the live and much discussed questions of the day. Without entering into the pros and cons of the subject, it may be said that weighty arguments can be advanced in favor of both systems—also that the relative economy of steam and water power is largely dependent on locality and circumstances. The latest phase of this subject is now in process of development, and is the result of the demonstration at Hamilton, Montreal, Quebec and elsewhere in Canada of the possibility of transmitting current at least over distances of ten to thirty-five miles, and supplying consumers en route and at the terminals at lower prices than could be offered by companies using steam to generate current on the spot. From this quarter has already come threatened competition to central station companies operating by steam in proximity to water powers, and it remains to be seen to what extent the present central stations situated within thirty-five miles of large water powers may find it most profitable to resolve themselves into distributing stations, receiving their supply of current at wholesale rates from an outside source.

Y.M.C.A. ELECTRICAL SOCIETY.

The summer course of the above society, organized by the electrical students in connection with the educational department of the Y.M.C.A., Montreal, opened on May 25th, when Mr. F. B. Horn delivered a lecture entitled "The Theory of the Telephone." The members have prepared quite an interesting syllabus for the summer months, the main feature being a series of lectures by practical men. The second one will be by Mr. J. C. Bray, of Messrs. Ness, McLaren & Bate, entitled "The Telephone in Practice." It is proposed to visit large electrical plants on the first and third Saturday of each month. Following are the officers: Honorary president, Prof. Herdt, McGill College; president, Mr. F. B. Horn; vice-president, Mr. R. B. Macdonald; secretary and treasurer, J. C. Bray, 419 St. James street.

The following gentlemen connected with the electrical industry of Canada attended the recent annual convention of the National Electric Light Association held in New York: Mr. Fred. Nicholls, general manager of the Canadian General Electric Co. (ex-president of the N.E.L.A.); Mr. W. H. Browne, general manager of the Royal Electric Co., Montreal; Mr. C. B. Hunt, manager London Electric Co., London, Ont.

Every person interested in electrical development—past, present or future—in Canada, is invited to participate in the Annual Convention of the Canadian Electrical Association at Hamilton on the last three days of this month.

TELEGRAPH and TELEPHONE

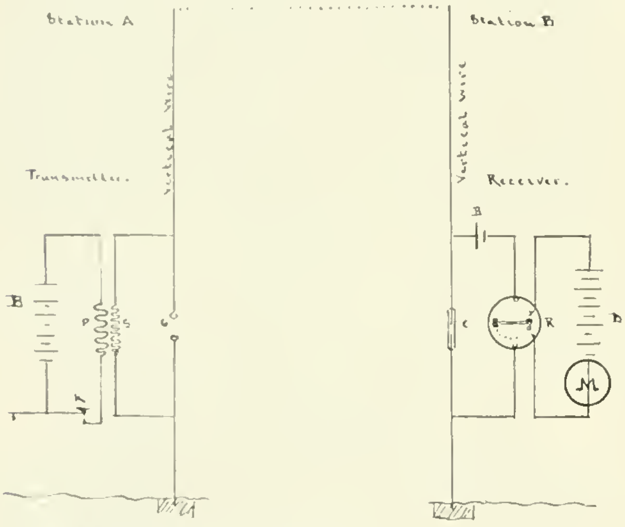
WIRELESS TELEGRAPHY.*

By F. A. Hamilton, M.I.E.I., M.Can.Soc.C.E.

Recent shipping disasters which have occurred, more especially on or near the Atlantic seaboard of Nova Scotia, render the consideration as to the best means to be employed with the object of minimizing such casualities particularly appropriate at the present moment, in view of the fact of marine insurance rates having been raised on vessels bound to and from Canadian ports.

That the subject is one of no inconsiderable importance, as far as Halifax is concerned, will be at once apparent to those whose interests are connected with the maritime enterprises of this city, and as these interests concern, to a very great extent, the whole province, the presentation of the following remarks will need no apology on the part of the writer.

The enumeration of the many accidents to shipping on and near these shores, which have been chronicled during the past twelve months, would here be superfluous. The mere mention of such losses of life and property as those involved in the Burgoyne-Cromartyshire collision, the wreck of the Moravia on Sable Island, and the loss of the Castilian, will suffice as instances. In studying the subject of marine signals, and particularly those placed near the coast for the purpose of guiding the mariner into port and warning him in respect to outlying dangers, the writer has recognized the advantage afforded by audible as opposed to visual signals. A system of electric buoys, to be placed at some distance from this harbour, was suggested in sundry communications, published in Halifax papers in 1891, and the general features of the proposed apparatus were fully described. Attention was again called to this subject in a paper read before the Maritime Electrical Association in September last. The proposal was regarded with favor by competent authorities, but as its practical application necessitated some considerable outlay, no encouragement was given to the scheme. But the advent of what is popularly known as "wireless telegraphy" renders the discussion of my proposed system of electric gong buoys, as far as the immediate object of this communication is concerned, for the present at least, unnecessary. The marvellous results now attained by means of the Marconi system of wireless telegraphy are so much in advance of those afforded by any other means that the question of improving the approaches to our coast and to our harbor is a comparatively simple one. The history of the various attempts to telegraph through space without the aid of intervening wires dates back, as far as the United Kingdom is concerned, to the early forties, but it is beyond the scope and objects of this paper to record the labors and achievements of those who have devoted their time and talents in the endeavor to perfect this long dreamt of project.



B represents an electric battery. K, telegraph key.
P S, primary and secondary of induction coil.
G, spark gap between metal spheres.
C, coherer. R, relay. M, Morse sounder.

The dotted lines indicate the invisible Hertzian waves, produced by the oscillatory discharges from the induction coil when the key K is depressed. The waves are intercepted by the vertical conductor at station B and conveyed to the coherer. The relay circuit is brought into action, in the manner already described, and the local battery and sounder M complete the cycle.

The natural and practical question is how and by what means is this astonishing annihilation of space now rendered possible. In an admirable work on this subject, Richard Kerr, F. G. S., says: "The great fact to be apprehended in connection, not only with the several systems of telegraphy without wires, but with many other departments of science, may be expressed in the following words: Throughout all the solid materials of the earth, through all the liquids and gases, through ourselves and our atmosphere, through the moon itself, through all the vast distance of ninety-three millions of miles between us and the sun, in fact, throughout all things too small to be seen by the power of the best microscope ever constructed, and through all the space ever reached by the largest telescope in the world, there exists a medium known as the Ether. In fact, all interstellar space across which light travels, whether from our sun or from any other star, is filled with this ether. It is through this mysterious medium that light travels. If a stone is thrown into the middle of a pond, a series of ripples or small waves cover the surface of the water

Similar waves are produced in the air whenever a bell is struck, and the ether has its waves also. The ether conveys energy from the sun in the form of waves. These waves vary in length. To one set we give the name of light, and the eye is adapted to the appreciation of these waves. The surface of the body feels the other waves and to these we give the name of heat. Other waves are detected by delicate instruments and to these we give the name of electricity and magnetism. As the eye receives the light, so Lord Kelvin says, the delicate coherer of branly is an electric eye, in that it is sensitive to electric waves. In wireless telegraphy, as in other systems, the use of two pieces of apparatus, the transmitter and the receiver, are necessary.

The Marconi transmitter, by means of which oscillatory vibrations are produced, consists of the following apparatus: A battery, or source of electrical energy, an induction or intensity coil, with terminal brass knobs at the extremities of the secondary coil, and an ordinary telegraph key. The knobs are so adjusted, relatively to one another, that the electricity induced in the secondary coil by the charging of the primary, will bridge the space (the spark-gap) between the knobs, and a succession of oscillatory discharges will take place, and give rise to waves, which travel in all directions. The receiving apparatus consists of the following instruments: The coherer or "electric eye," as Lord Kelvin describes it, a sensative telegraph relay, and an ordinary Morse sounder or writer. The coherer is a sealed glass tube, about two inches long, with wires leading out from each end, in the inner extremities nearly meeting in the middle of the tube, but with a space or gap between them, in which is placed a small the quantity of metal filings. In their normal condition these filings do not perfectly complete the metallic circuit formed by the outer ends of the wires, leading from the extremities of the tube, and the relay to which they are connected. But when electric waves caused by the oscillitory vibrations of the distant transmitter reach the coherer the small particles of filings immediately cling together or cohere, thus completing the circuit of the relay, bringing into action a small battery, when the armature of the relay closes the local circuit and the sounder or Morse writer responds to the signals.

A small tapper, in the local circuit, is caused to agitate the tube and decohere the metal filings, so that they resume their mormal position. A vertical wire at each station is an important part of the equipment that in connection with the transmitter imparts to the ether the vibrations set up at the sending station, and that at the receiving station intercepts the waves and conveys them to the coherer. This is by no means a full description of the appliances used, but it may serve to convey a general idea of the method employed to impart vibrations into space and to intercept them at a distant point. But it will be at once apparent that under some circumstances the radiation of signals in every direction would be an objectionable feature, not because a telegram so sent might become common property, but on account of interference or cross-signaling.

It is a perfectly easy and simple matter to read the messages now passing on an ordinary telegraph line, without disconnecting or even touching the wires, but no one ever takes the trouble to endeavor to become acquainted with other people's business by such means, and besides, all telegrams requiring secrecy are coded.

Nevertheless, there are conditions in connection with which the screening of the signals, either by the interposition of some non-absorbing substance, or the focussing of the radiations by means of projectors, or the syntonizing of the instruments, so that they will respond only to certain vibrations, would appear necessary, and it is extremely interesting to learn that this phase of the problem has been dealt with successfully.

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*Paper read before the Council of the Board of Trade, Halifax, N. S., May 16th, 1899.

Not that the idea would be here given that finality in this respect has been reached, for much remains to be done in perfecting details in connection with this all important feature, but it is encouraging to read the statement that a development of more than ordinary interest in this regard has been recently announced, viz : that cross-signalling has been eliminated, and that arrangements have been successfully introduced whereby interference has been prevented between three stations which heretofore interrupted or interfered with one another.

So many wild rumors are published by enthusiastic and imaginative persons with regard to the future adaptation of wireless telegraphy, that a word from the lips of Signor Marconi may be of interest in respect to such startling announcements as those lately advanced, to the effect that the next experiment would be between the South Foreland and Paris. In the London Electrician of April 28th, Signor Marconi is reported as stating "that he knew nothing of such an experiment or of any serious attempt being made to establish wireless telegraphy between Ireland and New York."

He expressed his conviction that real progress was only to be made by shorter stages, and that he was determined to undertake no share in any experiment likely to bring the Marconi system into disrepute, through complete, or even partial failure.

He is fully in agreement with Dr. Flemming's view that wireless telegraphy is quite unlikely to take the place of wire telegraphy for long distance commercial work, but for connecting islands or places separated by sea, the system is now available up to distances of 60 or 70 miles.

If the Canadian government contemplates expending $120,000 for a telegraph cable to Sable Island, it is a question whether it would not be wise to consider how far that sum might be advantageously applied in providing the lighthouses on the island and on our coast with the Marconi apparatus, for whilst it is not possible at present to span the distance between Whitehead and Sable Island by means of wireless telegraphy, the establishment of a station on the island would render communication therewith at all times possible to a vessel provided with the necessary instruments, and as the use of such instruments will probably be general in the near future the actual need of a cable to the island will be less imperative than it has been in the past.

Wireless telegraph stations on such headlands as Cape Race, St. Pierre, Miquelon, St. Paul's Island and other lighthouse stations up the Gulf, Louisburg, Whitehead, Egg Island and Sambro, could probably be established at considerable less cost than would be required for a cable to the graveyard of the North Atlantic, indeed it might with reason be argued that one of the best means of averting such disasters as those which have occurred on that dangerous sand bank would be to adopt the suggestion now outlined.

It is gratifying to learn that the Wireless Telegraph and Signal Company, of London, intend giving a practical demonstration of the Marconi system of signalling on this side of the Atlantic, about August next, and it is hoped that Halifax will be one of the places selected for the purpose. The question of providing a steamer for the pilot service for the port of Halifax is one that has been mooted from time to time, and like every other proposed measure for the improvement of the approaches to our harbor, deserves careful consideration.

If Sambro were provided with a Marconi apparatus and the pilot steamer were likewise so fitted, the efficiency of the pilot service would be considerably augmented, for many potent and obvious reasons. With the lighthouses mentioned, and those of Little Hope, Roseway and Seal Island, radiating their signals to a distance of twelve to fifteen miles in the offing, no well equipped vessel need meet the fate of those which have left their bones along these shores and in the deadly sands of Sable Island.

SHORT-CIRCUITS.

The Bell Telephone Co. are laying a number of underground conduits in the city of London, Ont.

The city of Brantford, Ont., has granted the Bell Telephone Co. an exclusive franchise for five years, for the consideration of $450 per annum.

The St. Martins Telephone Co., of St. Martins, N.B., recently held its annuul meeting and re-elected directors and officers. They are : John McLeod, M.P.P., president ; W. H. Allen, vice-president ; A. W. Mackin, secretary-treasurer and manager ; C. M. Bostwick, W. E. Skillen and C. D. Trudnen, additional directors.

The Carman Telephone Exchange Co., of Carman, Man., is applying for incorporation. The applicants include J. E. Campbell and F. D. Stewart.

E. W. Crane, of Brantford, has issued a writ against the city and the Bell Telephone Co. for $5,000 damages. While working as a lineman, he came in contact with a wire which was not properly insulated, receiving injuries for which he claims damages.

It is stated that the Dominion government intends to complete the telegraph service between Quebec and Belle Isle within the next two years. The line has already been built to a point 160 miles below Quebec, and an additional 200 miles will be strung this year.

A charter has been issued to the Victoria Telephone Co., to operate in the town of Lindsay and throughout the county of Victoria, with head office at Woodville, Ont. The directors are J. G. Eyres and C. E. Weeks, Woodville; Arch. Campbell, Lindsay; J. J. Cave, Beaverton ; W. H. Johnston, Pefferlaw.

Mr. Timothy Howard, telegraph engineer of the Australian post and telegraph department at Melbourne, Australia, is making a tour of inspection of the telegraph and telephone systems and other electrical developments in the principal countries of the world. He started from Melbourne last January, coming direct to San Francisco. He is travelling eastward and expects to get back home about Christmas time. He has visited the principal cities in the United States and Canada, and will stop at the principal centres in England and Europe. Mr. Howard sailed for England a few weeks ago.

Mr. T. A. Smith, district saperintendent of the Bell Telephone Company at Kingston, has invented special instruments of unique design for communication between the attendants on the surface and the divers at the bottom of the river, while they are engaged in the work of raising the Cornwall bridge. The ordinary diving apparatus has been dispensed with, and supplemented by special diving bells, so constructed as to withstand the pressure of the current. They are also protected by heavy metal shields. The telephone is put inside the bell, and electric alarms give the signal when either party desires to converse. Anybody can operate the ingenius mechanism.

MOONLIGHT SCHEDULE FOR JUNE.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 7.50	A.M. 1.20	5.30
2....	" 7.50	" 1.50	6.00
3....	" 7.50	" 2.20	6.30
4....	" 7.50	" 2.50	7.00
5....	" 7.50	" 3.20	7.30
6....	" 7.50	" 3.30	7.40
7....	" 7.50	" 3.30	7.40
8....	" 7.50	" 3.30	7.40
9....	" 7.50	" 3.30	7.40
10....	" 7.50	" 3.30	7.40
11....	" 8.50	" 3.30	6.40
12....	" 9.30	" 3.30	6.00
13....	" 9.50	" 3.30	5.40
14....	" 10.20	" 3.30	5.10
15....	" 10.40	" 3.30	4.50
16....	" 11.00	" 3.30	4.30
17....	" 11.00	" 3.30	4.30
18....	" 11.30	" 3.30	4.00
19....	....	" 3.30	3.30
20....	A.M. 12.00	.....	
21....	No Light.	No Light.	.....
22....	No Light.	No Light.	.....
23....	No Light.	No Light.	.....
24....	No Light.	No Light.	.....
25....	P.M. 8.00	P.M. 10.30	2.30
26....	" 8.00	" 11.00	3.00
27....	" 8.00	" 11.20	3.20
28....	" 8.00	" 11.50	3.50
29....	" 8.00	A.M. 12.20	4.20
30....	" 8.00	" 12.50	4.50
......	... .	....	.....
		Total.........	137.30

Without the least reflecting upon Montreal, Ottawa, Toronto or Niagara Falls, it can be stated that the Committee in charge of the local arrangements for the entertainment of those who may attend the C. E. A. Convention at Hamilton, will prove themselves to be past masters in the art of hospitality.

CHARGING CARRIAGE BATTERIES.

Electric carriages are coming into general use in the cities and towns where there are electric power stations, from the wires of which the storage batteries of such electric carriages can be readily charged. Some other method of charging such batteries is greatly needed. Could a simple and practical method of charging such batteries be used anywhere it would enable residents of country districts to use electric carriages. The writer has devised two methods. The first method consists in the use of an endless tread power to drive the motor of the electric carriage as a dynamo to charge the storage battery on the electric carriage while the latter is stationary and at or near the home of the user, or wherever such a tread power can be used. If the owner of the electric carriage has no horse to operate the tread power, either a donkey, a mule, an ox or a cow can be pressed into service to operate the tread power and drive the motor of the carriage as a dynamo to charge the storage battery on the electric carriage. In rural districts where engines are not available the tread power could also be used to thresh, clean grain, saw wood, cut straw, hay and roots, pump and churn without the intervention of the carriage motor used as a dynamo, and without the intervention of the storage battery.

The farmer could make one of his horses charge the storage battery in the manner outlined, and he could still keep the horse at home to do necessary work on the farm while the members of his family might drive a dozen miles and return by means of the electric energy which might be stored by the exertion of the horse, mule, donkey, ox or cow during the previous evening. Of course, absolutely no harness whatever would be required by the horse, donkey, mule, ox or cow while driving the endless tread power. No time need be spent in grooming the animal, and he need not be shod. A fractious animal might store his energy in the storage battery, and no runaways need be feared by the user of the electric carriage. When the carriage is not needed at night the electric energy stored in the carriage battery by the work of the animal at any time during the day might supply light for the house at night by means of incandescent electric lamps. Should it be preferred, the animal may operate the motor of the carriage as a dynamo at night, and so illuminate the house during the night without the intervention of the storage battery. But if the carriage is to be used at night a storage battery for the purpose of illumination may be installed in the house.

It is well known that the endless tread power is the best contrivance for utilizing the energy of animals. The animal while at work simply walks up an incline plane made of a belt of heavy slats which passes under him as he walks, and turns a wheel connected with the motor used as a dynamo by simple belting. The economy of the endless tread power is due to several causes. In the first place, the animal has to carry no load of harness; in the second place, he always walks on a good road, and in the third place he may walk at a uniform rate of motion.

Really, in the present age it seems absurd when a person wishes to drive a dozen miles away in order to remain a day or two, to hitch a huge beast, loaded with harness, to the carriage, and to use him but a small fraction of the time while absent from home. A horse is used to draw the carriage even though often not more than one-quarter of a horse power is really needed for the work. The horse while absent from home must be unharnessed, fed, watered, groomed and provided with a stable; all this causes considerable trouble, anxiety and annoyance. The horse, while drawing the carriage, may shy and run away because of rustling paper or other trivial cause, and endanger the lives of the occupants of the carriage. The roughest and most unsightly and ungovernable beast may store his energy in the carraige battery in the method outlined.

The user of the electric carriage, when on the road, may drive the same at either a high or a low speed; there is no danger of runaways; on arriving at his destination the electric carriage requires neither food, water nor care. He may let the vehicle stand still out of the way until it is again required for use.

The second method consists in using either small kerosene or gasoline engines, in the rural districts, to drive the motor of the electric carriage as a dynamo to charge the battery. Such engines are now sold at low prices and they are very economical in the use of fuel. In some cases steam engines already in use for other work may be used to charge the battery. These engines may also work the carriage motor as a dynamo to store electric energy for lighting houses, and they may also be used in threshing, cleaning grain, cutting feed, sawing wood, pumping and churning.

It will now be thoroughly understood that nothing need now prevent the extensive use of electric vehicles of every description, either in the country districts or in small villages and towns where there are no electric power stations. The country roads may soon be everywhere traversed by horseless carriages. The advantage of cleanliness, speed and convenience of such electric carriages are very great indeed.

The principle novelty in the methods outlined in this article consists in the use of the carriage motor as a dynamo for charging the storage battery of the electric carriage, instead of incurring the expense of installing a dynamo on purpose for such use.

James Asher,
174 Germain St., Buffalo, N.Y.
May 23, 1899.

Gore Park, Hamilton.

Good Morning! Have you read the advertisements in this Number?

THE POSSIBILITIES OF LIQUID AIR.*

By Elihu Thomson.

The object of the present article will be to suggest rather than predict directions in which, under certain conditions, liquid air may possibly become a factor in engineering. And in the absence of favorable conditions need it be said that such possibilities will not be capable of realization.

Let us assume the availability of some innocuous gas liquefiable at about one hundred atmospheres pressure, at temperatures easily and cheaply attained, and at no cost for the gas itself. In such a case there can be no doubt of its soon finding enormous application in the storage and recovery of energy. Cheap power would be used to compress and liquefy it, after which it would be stored in quantity, either at atmospheric pressure or at some selected higher pressure. Such a liquefied gas would be stable, or remain in the liquid state, if heat were prevented from reaching it. This could be done, not perfectly, of course, by surrounding the containing vessel with a liberal thickness of some good non-conductor of heat. That part of the gas which would inevitably escape on account of the lack of perfect heat insulation would be cold and would be made to traverse the non-conducting covering in successive layers from within outward, and thus assist in cooling the covering and in preventing access of heat to the liquid; or, the escaping gas might even be made available for power in an engine, if the liquid were kept under a proper working-pressure. In this case further heating of the gas, analogous to superheating of steam, could be employed before sending it to the engine. But little of the energy of the heat so added would be lost, and a considerable part of it could be supplied by the surrounding air or by water.

With such a liquefied gas produced at one place by cheap power and carried to another for evaporation and recovery of power, ice could be made as a by-product.

In many plants used for the development of power on a large scale, a twenty-four hours' output is not called for, but could be attained at slight additional expense. The excess power from such a plant needs some means of utilization. This excess power, as during periods of otherwise light load, could be employed to liquefy the assumed gas. On a large scale this procedure would not be costly, supposing the use of highly developed machinery. The liquid product could then be transported in tanks provided with heavy lagging and special arrangements to prevent access of heat from the outside. Perhaps it could be distributed by a well-covered pipe-line. The unavoidable evaporation which would be involved in the pipe-line transportation might not be altogether a loss, for if the line be under a pressure suitable for engines the escaping gas might possibly be tapped out at intervals, heated, and used for power along the line of way.

But the foregoing considerations are based upon the existence of a gas at no cost, with desirable properties rendering its liquefaction easy. Such a gas does not in fact exist. There then arises the question whether we can render available any of the gases known to us. Carbonic acid gas is cheap, but still far too costly for use in the way proposed. It would not pay to send it back long distances for recompression and reliquefaction. It costs too much to be thrown away after it has been once used. The air itself meets the condition of no cost for material in the case.

In culmination, Professor Dewar has lately succeeded in reducing even hydrogen to a liquid and in collecting quantities of it. Temperatures not far removed from absolute zero (−273° C.) are obtained by the evaporation of liquid hydrogen. But the absolute zero, like the dynamo of 100 per cent. efficiency, may by each advance be more and more closely approximated but never reached. This low temperature research has shown that at temperatures as low as—200° C., attainable by evaporation of liquid air, conducting-metals, as copper, platinum, silver, etc., when in a very pure state, have their conductivities so much enhanced that electric currents flow with but a fraction of the resistance experienced at ordinary temperatures. Research has shown that at absolute zero they would become perfect conductors. Professors Dewar and Fleming laso found that liquid air is a very perfect insulator, and that ice and many frozen electrolytes even become excellent insulators at the temperatures of liquid air; and in general that intense cold in insulators improves the insulation, just as it improves the conductivity of conducting-metals when they are pure.

Unfortunately, however, the liquefaction of air requires rather extreme conditions, and in the early work of Dewar was an exceedingly costly process.

The discovery of the fact that air compressed, cooled, and collected in a reservoir at from 100 to 150 atmospheres might be made to liquefy a portion of its own volume, rendered possible the procuring of liquid air by a more direct and simple means. This discovery is claimed by several persons, the merits of whose claims will not be here discussed. When highly compressed air escapes from a suitable orifice it is cooled by its own expansion. If the cooled air be now caused to circulate around a long coiled pipe, which brings the compressed air to the jet in such a way that the portion of pipe nearest the jet is the first to be met by the cooled air, and so back progressively from the jet; further, if the whole be thoroughly jacketed by a non-conducting covering the temperature at the jet soon falls sufficiently low to cause liquefaction of a portion of the air even at ordinary atmospheric pressure. The operation itself is cumulative or self-intensifying, since the cooling due to expansion is employed, on the regenerator principle, to cool most effectively the compressed gas on its way to the jet and ready to expand.

If air be compressed to about 800 atmospheres it may be made to occupy the same space as it does when liquefied, but even at higher pressures it would remain gaseous. Ordinary temperatures of the surrounding air are far above the critical temperatures of the gases composing it. In order that it may liquefy, it must lose kinetic energy or be cooled; the velocity of the moving molecules must be brought down. The removal of heat is essential, and the process of liquefaction can only be carried on by cooling the gas during or after compression. Conversely, liquid air confined in a closed and filled receptacle, when allowed to regain the heat lost in being liquefied, would become gaseous and exert a pressure of about 6 tons per square inch.

That the processes for producing liquid air will be developed so as to reduce the cost to an extent such as to render it available in place of a more ideal gas would be a vain prediction to make at present.

The fact that a three-gallon milk-can of liquid air was brought by Mr. Tripler, of New York, from that city to Lynn, Mass., a journey occupying nine hours, and that not more than one-third of the liquefied gas was lost, although the only covering for heat insulation was about 2½ inches of ordinary steam-pipe felting, goes far forward indicating the possibility of transportation. With a tank of 20 times the linear dimensions of the milk-can referred to, the surface for loss of heat would rise to 400 times, while the capacity would have increased to 8,000 times, and with no better lagging it is easily seen that the daily loss would then not be over 5 per cent. Doubtless, however, improved means for heat insulation would make the loss but a fraction of this amount. If the tank were kept under a pressure of, say, 200 pounds to the square inch, a suitable safety-valve being provided to prevent excess of pressure, the evaporated gas or air could be made to do work, especially if superheated. If the tank were in a train the motive power might, at least in part, be derived from the normal evaporation from the tanks. Further, let us imagine a pipe-line well insulated for heat, and it is easy to see that if the velocity of flow equalled the train-speed in the journey of the milk-can from New York to Lynn, the percentage loss in a pipe of the diameter of the milk-can with no better lagging than it possessed would be the same or even less. Here again perfection of heat-insulation might make quite a saving, and the evaporated gas might, if the line were under pressure, be made available for power along the line of way.

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* Abstract from contribution in the Engineering Magazine.

Whether the liquefied gases of the air can be employed in this way will, however, depend upon the development of efficient methods of extracting the heat and effecting condensation of the air.

Liquid air represents air compressed to about 800 atmospheres, but existing without pressure. No heavy and excessively strong tanks are needed for storing it. If it be pumped into a closed receptacle under regulated pressure, it may be evaporated by the heat of the air, or that of surrounding objects, or it may receive heat from bodies undergoing refrigeration, as water being converted into ice ; after which heating operation it may be further heated to the melting point of lead by heat of combustion, and be finally used in a suitable engine where its expansion may develop power. During its expansion and delivery of power to the pistons of the engine it may become so cooled as to be discharged from the exhaust at nearly normal atmospheric temperature and pressure.

The power expended in compressing and liquefying air is, of course, converted into heat and thrown away. The product, liquid air, has no inherent power of energy in itself. It represents negativity, bearing somewhat the same relation that an exhausted globe does to the surrounding air. It may become the means for rendering the normal energy in the surrounding air available. Liquid air has capacity for taking up the ordinary heat of surrounding objects and thus acquiring pressure. It can be superheated very efficiently, and so used in the form of compressed air in an engine. The superheating will, of course, tend to raise greatly the total efficiency. The inevitable losses in the compressing and liquefying processes would in part be made up in the added heat, the amount of which is small and efficiently employed. We have no reliable data of large scale operations, and can as yet reach no certainty as to the efficiency attainable in compression and liquefaction or in recovery of power. It is possible that the seperation of oxygen, which would probably possess a value in metallurgy, might tend to diminish the cost of condensation. So also the refrigeration which is obtained during evaporation might help the recovery end. Where so much is "in the air" we must be content with suggestions only, and they may never be realized in practice. The power required to be expended in liquefying a given amount of air can be approximately estimated, and an assumed efficiency of plant may be made to do duty in place of exact figures where none are to be had, and if the conclusions based thereon are understood as tentative and subject to extensive modification in view of further advances in our knowledge, no harm is done.

In making an estimate of the cost of liquid air as produced on the large scale, the factors of plant efficiency, maintenance, etc., come in to a greater or less extent. Assuming that air be compressed as nearly isothermally as possible, and that in a large plant a possible total efficiency of seventy per cent. might probably be realized, each horse power hour might thus be expected to compress nearly 10 pounds of air to a pressure of 2,000 pounds to the square inch. If such compressed air, on being expanded in a very carefully arranged self-intensifying apparatus, should condense 25 per cent. of the air admitted, we would have about 2½ pounds of liquid air per horse power hour. The assumed proportion, 25 per cent., seems not improbable in view of all the data—meagre enough, it is true—which have come to the writer's knowledge.

If the power cost be taken at $20 per year in large units and an additional charge of $10 be allowed for each horse power of the compressing and condensing plant, its interest, maintenance, and operating expenses, the cost per pound of liquid air would be about one-sixth of a cent, assuming the plant to run 7,200 hours per year. This estimate, subject to modification from the very nature of the problem, would make the liquid air cost for production about 8 cents per cubic foot. If oxygen separated by fractional distillation possessed a value for equal amounts in excess of the cost of the air, the remaining nitrogen would, of course, be producible at a lower figure.

It is probably within the possibilities that a cubic foot of liquid air or nitrogen, if allowed to heat from its surroundings and then be further heated to 200° C., could, in a high pressure engine, yield about five horse power hours. If at the same time the vaporization of the air were attended by useful refrigeration, as in making ice, the cost of recovery would diminish. Need it be said here, however, that even if the cost of horse power of recovered energy much exceeded that which is indicated in the foregoing estimates or assumptions, a demand may still exist for a source of power having great compactness, freedom from nuisance, no heated nor noxious exhaust, and of unequalled controllability? The horseless vehicle problem certainly presents us with an instance in point.

The great feature of the application of such a power as liquid air would be its emergency value. By this is meant the ability to obtain at will a sudden output far beyond the normal. Animal power notably possesses this emergency value, and the success of electric trolley systems largely depends upon the fact that, when needed, the station can be called upon for a temporary delivery to any single car or train of a power greatly in excess of the rated output of the motors.

Suggestions have already been made of the use of liquid air or oxygen, mixed with combustibles as a high explosive. Such an explosive can be made at the time of use, and if left unexploded, either by accident or design, soon loses its dangerous character by evaporation of the liquid gas.

A fascinating speculation for the electrical engineer is the possibility of so cooling the conductors of electric lines or apparatus as to improve the conductivity many times, and so diminish the losses in any given length of conductor, and at the same time greatly improve the insulation. Professors Dewar and Fleming have shown, however, that it is a condition of this enormous improvement in conductivity that the metals be very pure, a very small percentage of impurity greatly lessening the result. As regards the insulation, they have shown that dielectrics and electrolytes become insulators of excellent character when cooled to the temperature of liquid air. What effect such a lowering of temperature would have upon the dielectric strength or striking distance between conductors at great differences of potential is not as yet determined, so far as the writer is aware. The result to be expected from a consideration of the effect of heating upon dielectric strength or striking distance is, that very low temperature will make it far more difficult to break down insulation by sparking through it.

That the electrical engineer covets just such agencies as will thus extend the range of possibilities in his art needs no proof. He would be apt to choose a pipe line conveying liquid air as the very best location for his conductors, assumed to be made of as pure metal as possible, the high insulation probably attainable being the chief object. Whether his conductors were placed outside such a pipe or within the same, he could no doubt adapt himself to the conditions, provided he could get the benefit of the low temperature insulation, and possibly, to a certain extent, a gain in conduction.

It is indeed very questionable whether a pipe line will ever be laid and kept filled with liquid air solely for its electrical benefits, but if such a line were also used to supply liquid air to a distant point and the normal evaporation utilized, the case would be somewhat modified, though the improbability of such a combination being put into service, at least within any reasonable period, still remains.

It will be the proper attitude for the conservative and at the same time progressive engineer to await the possession of full and accurate data before drawing any conclusions as to future practice. Suggestions of possibilities are, of course, useful, even if only a fraction of them prove realizable, and no attempt is here made to do otherwise than call attention to matters which must from their nature possess more or less of interest.—Engineering Magazine.

Mr. R. A. L. Gray, electrical contractor, Toronto, has removed to 42 York street, having secured the agency of the Electrical Construction Company, of London, Ont.

A by-law will be submitted to the ratepayers of Nelson, B.C., authorizing the council to grant a charter for a tramway system in Nelson to the British Electric Traction Co., of London, Eng. The company's solicitor is Mr. W. A. Macdonald.

The United Electric Company, Toronto, have recently sold 2 h.p. motors to the following: Brereton & Manning, Langmuir & Co., T. H. Patriarche, A. R. Williams Co., and Imperial Cap Co., Toronto: Brock Engraving Co., London; R. B. Dobson, Beaverton; R. E. T. Pringle, Montreal. They have also sold to Mr. Dobson one 4 h.p. motor and one 6 h.p. generator, and to R. E. T. Pringle one 6 and one 8 h.p. motors.

SPARKS.

The town council of Barrie, Ont., are taking steps looking to the construction of a municipal telephone service.

Mr. J. L. Kitchen has removed from Wiarton to Acton, Ont., to take charge of the municipal lighting plant in that town.

The Bell Telepone Co. are now constructing a long distance copper line between Ottawa and Brockville. The line will require about 75 miles of poles and cross-arms and 200 miles of copper wire.

Robert Hunter, Joseph Murchey and associates have been incorporated as the Gasoline Engine Co., of Toronto Junction, to manufacture gasoline and gas engines, steam engines, electric motors, etc.

The council of Wallaceburg, Ont., have refused to grant an electric light franchise to Mr. M. Martin, and have entered into an agreement for street lighting with the Wallaceburg Electric Light Company.

The ratepayers of the village of Thurso, Que., have approved of the by-law to raise $18,000 to purchase and complete the waterworks and electric light plant started last year by the Stadacona Electric & Water Co.

The town of Renfrew, Ont., has given a contract to A. A. Wright & Co. for six arc lights, at 25 cents per light per night, and to W. A. Mackay for 15 incandescent lights, at $20 per light per year, both contracts to be for one year from May 3rd, 1899.

The Bear River Electric Light & Power Company have decided to extend their system to Digby, and to light intermediate points. The capital has been increased to $75,000, and it is understood they will take over the plant at Digby owned by Major Daley.

A syndicate of Toronto gentlemen are said to have purchased the franchises and property of the St. Hyacinthe Power and Electric Light Company and the St. Hyacinthe Gas Company, of St. Hyacinthe, Que. It is given out as the intention of the syndicate to rebuild a portion of the dam at the power house and to remodel the electric system.

The Hull Electric Company has entered suit in the Superior Court against the Ottawa Electric Company, claiming $10,000 damages for non-compliance with their request to cease selling light in Hull. This sum is alleged to have accrued since the last action for $20,000 on the same grounds was issued. The latter is still pending before the Court of Appeal in Montreal.

Oliver Perks, an electrician, of Montreal, was recently killed at the power house of the Chambly Manufacturing Company at Chambly. Perks and some other employees were laying the current on a new machine. Perks wanted to find out for himself the progress being made on the machine. He leaned over it, putting the tips of his fingers on the frame and stretching his other hand down. In the act his hand came in contact with some wire, thereby establishing a circuit and causing a current of 3,000 volts to pass through his body. Death was almost instantaneous.

Recent sales made by the United Electric Company, Toronto, include the following: $3\frac{1}{2}$ h.p. motors to J. T. Rowan, Ottawa, and Telegraph Printing Co., Waterloo; 4 h.p. motors to Merchants Mantle Manufacturing Co., Toronto; 5 and 6 h.p. motors to Citizens' Telephone & Electric Co., Rat Portage; 7 h.p. motor to James Sparrow & Co., Toronto; 8 h.p. motors to Federal Printing Co., Ottawa, Toronto Lithographing Co., Northway & Sons, and Elliott Paper Box Co., Toronto, Clark Creamery Co., Smith's Falls, and Darling Bros., Montreal; 10 h.p. motors to Brown & Hussey, Toronto, Rogers Coal Co., Hamilton, and W. J. Babcock, Brantford; 12 h.p. motors to Elias Rogers & Co. and A. R. Williams Machinery Co., Toronto; 20 h.p. motor to Rice Lewis & Son, Toronto.

The Cataract Power Company have made a proposition to light the streets of the city of Hamilton, the contract to apply to the unexpired term of the existing contract with the Hamilton Electric Light & Power Company, viz., September 1, 1900, and for a further period of ten years. They offer to furnish 425 arc lamps of 2,000 nominal candle power, burning from dusk till dawn of every night of the year, at the rate of $85 per lamp per year, and additional lamps at the rate of $82.50. Should the city require 500 lamps or over at any time during the term of the contract, the price would be $82.50 for the first 500 lamps and $80 for each additional lamp. A rebate of 2 cents per lamp hour to be made for such time as the lamps may not be burning. The company announce their intention, should the proposition be accepted, of thoroughly remodelling the present arc lighting system.

ELECTROLYSIS.*

By F. Walter Thorold.

The great damage done to gas mains, water mains and the cables of the various electric and telephone companies by the return current of the electric railway systems, is now assuming such large dimensions that something must be done to overcome it. If this trouble is left to take its own course, there will, no doubt, be numerous law-suits in which the railway companies will be the losers. They will have to pay for damages done to these pipes and cables, and will also have to so equip their outside plant that this trouble will not occur again.

There may be a doubt in the minds of some people as to whether the electric railway companies can be held responsible for the damage done by their heavy return currents. The argument amounts to this: Certain companies have capital invested in metal, which is placed underground. Another company comes along and destroys this metal. The question then is, is this last company responsible for the damage they have done and are still doing? They may not be doing this damage intentionally, but they are doing it knowingly.

It is a well-known fact that electricity will choose the path for itself which offers the least resistance, but that it is impossible to confine the current to one conductor when there is another open for it, no matter what the resistance of the other may be. Still, it is the duty of the electric railway companies to provide a conductor on their return circuit over which the greater part of the current will flow, and that conductor must offer so little resistance that all the current which does not return over it will not be enough to cause any damage to the underground pipes and cables.

Electrolysis may result to a small extent from the leakage of overhead wires, but as this leakage takes place to such a very small extent, it is not worth considering. Of course, any large leakage of this kind, or a "ground," as it is called in practice, would soon be known at the power house and taken off at once.

The circuit of the ordinary trolley system is very simple. The current comes along the trolley wire from the dynamo in the power house, thence through the car to the rail, and along the rail and underground pipes, etc., back to the dynamo in the power house. If the current all returned along the rails there would be no damage done by electrolysis, excepting perhaps at a few bad joints between the rail and its connections.

A few words might be said as to the connections between the rails now generally used. The rails are bolted together by means of ordinary fish-plates; but to make a better electrical connection they are bonded together by heavy copper wire. This bonding is supposed to so connect the rails that the current will flow on unmolested to the power house. The method of bonding now used is to take a piece of No. 0 or No. 00 bare copper wire, as short as possible, but generally about eighteen inches in length, to each end of which a rivet, called a channel pin, is soldered. There is a small hole drilled in the end of each rail, into which the channel pin is put, and the end is then flattened out, thus connecting the rails together. However, it has been found that this is not enough, as some of the current leaves the rail, on account of the resistance between the joints, and follows along the underground mains and cables to the power house. If the current, while travelling along these pipes, was not increased or diminished on the way, or in other words, if the potential between the pipes and the rails was always the same, there would be comparatively little harm done. The trouble is that the current takes jumps to and from the pipes as the resistance of the rail increases or diminishes, and at every point in the pipe where this takes place—and the points are many—electrolysis sets in.

The method of bonding before mentioned does not make a true electrical connection. The connection between the pin and the wire may be all right, but it is the connection between the pin and the rail which causes the trouble. By continual pounding of the cars on the rail the joint is loosened, and the result is that an oxide of the metal is formed, thus increasing the resistance of the joint, and ultimately of the whole circuit, and thereby causing more of the current to return through the pipes, etc.

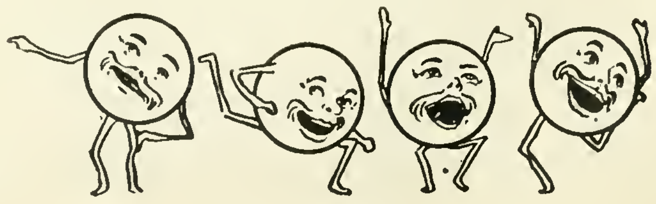
One system which is used is to connect the rails every short distance with an overhead insulated copper wire, which carries the current back to the power house. Of course, the system of bonding mentioned is also used, or otherwise it would be necessary to connect every rail with the overhead wire. It will be readily seen that with so little resistance offered, very little of the current would seek any other path.

A sixty-pound rail is said to be electrically equivalent in carrying capacity to one square inch of copper, and therefore, in a double-track road, the rails offer a combined carrying capacity for the current equal to four square inches of copper. If the bonding between the rails is made perfect, and the overhead return wire is used, then I think the trouble of electrolysis would be a minimum.

In several cities the rails have been casted together at the joints by placing a mould about the rail ends and pouring molten iron in, which on solidifying formed a solid joint. A first-class electrical connection may thus be obtained, but it has been found to be almost impossible to have an easy running road with joints of this kind, and as this is an expensive connection, it is not very largely used.

The effect of electrolysis is first noticed near the power house, as it is near this point that the current, which has been collecting on the pipes, jumps up to the rail to return to the dynamo, thus causing the oxidation of the pipes at this point. This oxidation, it must be remembered, has been and is going on at many other points of the pipes, although not to such a great extent, but it is only a matter of time when the same trouble will be located on these other sections of the pipe, throughout the city or town.

Outside of all damage done to other property, the electric railway companies are wasting money. To decompose a metal some force must act, and in this case the force is supplied by the railway company. They are, therefore, spending money to decompose these metals, as well as spending money to operate their cars. Why not put in good return wires and save this money? The saving just now would be a negative quantity, but in the end they would probably be the gainers.



The joys of Anticipation—The Realization can be had by attending the Electrical Convention at Hamilton.

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*Abstract from pamphlet of Engineering Society of School of Practical Science, Toronto. Published by permission.

THE LATE DONALD GIBSON.

THE late Donald Gibson, city electrician of Toronto, whose portrait appears on this page, was one of the best known of the older citizens. His connection with the fire brigade as superintendent of the fire alarm system extended over the long period of twenty-seven years. Mr. Gibson was a native of Glasgow, Scotland, and came to Toronto in 1854, to enter the service of the Consumers' Gas Company. He was foreman there until he entered the city's service. He was an ardent volunteer. As a lieutenant in the Highland Company of the Q.O.R., he was present at the Ridgeway fight. Afterwards he became captain of the Garrison Artillery. He was a first-rate rifle shot, and was a member of the first Wimbleton team sent from Canada. Mr. Gibson was one of the founders of the Caledonian Society, a strong Reformer in politics, and a member of Old St. Andrew's church.

THE LATE DONALD GIBSON.

SPARKS.

The United Electric Company, Toronto, have sold a 1½ k. dynamo to Toronto University.

Tenders have been invited for wiring for electric light the municipal buildings at Winnipeg.

Ed. Plante and Z. Plante have formed a partnership in Montreal as electricians, under the firm name of Plante & Co.

Some improvements have recently been made to the electric light plant at Huntsville, Ont., under the superintendence of Geo. Ralstan, electrician.

Mr. Champagne, boiler inspector, Montreal, in a report to the Water Committee, recommends the addition of a pump of 5,000,000 gallons capacity, either worked by steam or electricity.

Steps have recently been taken to form a trust of the manufacturers of rubber covered wire in the United States. Options have been obtained on the purchase of the business of the leading firms.

The authorities of the town of Goderich, Ont., will probably make an addition to the electric light plant. The Light Committee have recommended that the council purchase 1,900 feet of No. 6 insulated wire.

The Lunenburg Gas Co., of Lunenburg, N.S., have changed their lighting system from direct current by steam to alternating current by water power, and are offering for sale their entire direct current plant.

The London Electric Company are still engaged in the work of remodelling their power house, and have placed an order with the Canadian General Electric Company for a complete marble panel switchboard, consisting of sixteen panels.

The Quebec government will offer for sale on June 8th the water power of the river Ottawa, opposite the township of Onslow, comprising the rapids and falls of Les Chutes des Chats. The purchaser must agree to spend $300,000 within three years in developing the power.

It is estimated that in the United States nearly 1,000,000 h. p. produced by electricity is used annually for the driving of pulp machinery. Such an extensive application reiterates the necessity for electrical engineers to become acquainted with the laws and practice of hydraulic engineering.

The Canada Tool Company, of Dundas, Ont., are in receipt of a large order from the Dominion Bridge Company, of Montreal, for special machinery. The large punches are to be operated electrically by motors directly attached to the machines, and for this purpose an order has been placed with the Canadian General Electric Company for four of their latest enclosed slow speed C.E. motors.

The city of Winnipeg, Man., have invited tenders for the supply of one 100 h.p. high speed engine for electric light plant, together with shafting, pulleys, belting, etc.

Mr. J. P. Graves, manager of the Granby Consolidated Mining & Smelting Company, states that it is the intention of the company to build a large smelter at Grand Forks, B. C. The smelter will be located on the Kettle river, power to be obtained by damming the river at a narrow canyon one mile above.

The British Columbia Electric Railways Company, of Vancouver, B. C., have declared their first dividend of 5 per cent. per annum on preference stock and 4 per cent. on ordinary stock. During last year the company made profits of $81,000, half of which was devoted to paying the dividend and the balance placed in reserve.

The Still Motor Company, Limited, of Toronto, has been granted provincial incorporation, with a capital of $75,000, to manufacture batteries and other appliances for propelling carriages, street cars, etc. The provisional directors are W. J. Still, Thos. Bengough, L. W. Doran, C. W. Chadwick and Joseph Heighton.

Messrs. Thos. Ahearn, John Murphy and W. Wylie, of Ottawa, visited the Electrical Exhibition in New York last month. Mr. Ahearn states that there was a splendid exhibition of horseless carriages, from automobile hose wagons to broughams. It is probable that the Ottawa Car Works may manufacture automobiles at an early date.

The Trenton Electric Company, of Trenton, Ont., expect to have their transmission lines at Belleville, Ont., completed very shortly, when they will be in a position to furnish power to the various manufacturers of that place. Mr. R. J. Graham is one of the first to avail himself of this power, and has alrdady contracted for about 50 h.p. He has also placed an order with the Canadian General Electric Company for one 30 h.p. and one 10 h.p. three phase induction motors for operating refrigerating machinery, hoists and fans in his cold storage establishment.

The Montreal Cotton Company, of Valleyfield, P.Q., are making some very extensive additions to their electric plant. They have at present installed four 600 h.p. three phase generators manufactured by the Canadian General Electric Company, and have just placed an order with the same company for a large 2,000 h.p. generator of the revolving field type, together with switchboard panels complete. They have also ordered two 85 k.w. exciters, these having sufficient capacity for furnishing exciting current to the full equipment of generators. Upon the completion of this additional installation this company will have the largest and most up-to-date isolated power plant on the American continent.

Mr. W. H. Whiting, of Boston, Mass., has patented an electrical fire engine, mounted on wheels like a steamer and consisting of a rotary pump and electric motor. It is 25 per cent. lighter than the average steam engine and the motor has double the power. The current for running the motor is obtained by erecting a post about ten feet from the hydrant, and connecting this with the nearest source of electrical supply. The current is transferred from the switch-box on a post to the engine by two flexible conductors, which can be attached instantly and the engine be ready for use before the hose is laid.

The Canadian General Electric Company are introducing a series alternating arc lighting system to their patrons, which permits of the operation of arc lamps in series from an alternating current generator of any standard periodicity. This will undoubtedly fill a long felt want and will tend to revolutionize the systems now in use for street lighting. Appreciating the advantages to be obtained, the Sherbrooke Gas & Water Company, of Sherbrooke, Que., have placed an order with the Canadian General Electric Company for a complete equipment of one hundred of these lamps, with transformers.

The Railway & Engineering Review states that the North-Western Elevated Railway Company, of Chicago, has entered into a contract for 150,000 pounds of aluminum feeders. Three sizes of bare cables will be used, viz., 786,000, 1,000,000 and 1,300,000 circular mils in area respectively. The largest feeder will be about 1½ inches in diameter. Of the two larger sizes there will be two cables of more than 10 miles in each. The feeders will be placed in a wooden box or trough covered by a board walk, between the tracks, and they will be supported on virtrified clay rocks of umbrella shape, placed 9 feet apart. The contract was made on the basis that 47 pounds of aluminum are equal in conductivity to 100 pounds of copper. Experiments carried out by the electrical engineeriug department of the road have demonstrated that 157 circular mils of aluminum are equivalent in carrying capacity to 100 circular mils of copper.

For some months past it has been reported that the water power at Fenelon Falls, Ont., was to be developed for the purpose of transmitting electric power to Lindsay, Ont., a distance of 14 miles. We are informed that the undertaking has been definitely decided upon by the Light, Heat & Power Company, of Lindsay, who expect to have the new plant in operation by the 1st of October. They have commenced the work of construction and are arranging plans for the development of about 1,200 horse power. The electric plant will eventually consist of two 400 k. w. three phase generators direct coupled to turbines. They have placed an order with the Canadian General Electric Company for one 400 k.w. generator, together with switchboards, step up and step down transformers, and all the apparatus required to complete the electrical installation. We expect to give a detailed account of this enterprise in our next issue.

ELECTRIC RAILWAY DEPARTMENT.

ELECTRIC RAILWAY IN JAMAICA.

The following account of the electric railway at Kingston, Jamaica, of which Mr. H. Holgate, late of Montreal, is manager, is given by the United States consul there :

For some years there has been a mule railway in Kingston, but an electric road covering the lines of the old cars and other thoroughfares as well has just been completed. This new line has about 25 miles of track in and around Kingston, divided into three districts, viz., the lines north of the city, those east of the city, and those in the city. It is a private enterprise, started by Canadian capital, and is called the West India Electric Company. The Government license is for a period of 30 years, renewable for further periods at the pleasure of the governor. The company pays four per cent. of its gross earnings to the government, and assumes the maintenance of the roads and streets occupied by it to the extent of 18 inches on each side of the tracks.

The rates of fare are 4 cents for each passenger from any point within a district to another point in the same district by most direct route ; that is, the fare is practically 4 cents for each section of the line, and from the end of the line to the east, through the city to the end of the line north, would be three fares, or 12 cents. In addition, the company reserves three front benches on each car, on which a first-class fare—6 cents—is charged. The tickets are sold as follows : Seven 4-cent tickets for 24 cents, five 6-cent tickets for 24 cents, and ten children's tickets, for under 12 years, for 24 cents.

Passengers are allowed to stand. There are no restrictions as to number of passengers carried, and the same complaints of overcrowding are heard. Cars run every 15 minutes in the city. In addition to regular motors, this company runs market cars before 9 a. m. and after 5 p. m. for country people who carry produce. These cars are trailers, and the fare on them is 3 cents.

STREET CAR FENDERS.

Mr. Duncan McDonald, superintendent of the Montreal street railway system, recently spent a couple of weeks in the United States, on a tour of inspection of the various railways in the principal eastern cities, with a view, particularly, of investigating the merits of the different fenders in use. He found that most every class of fender that has been invented was used. It had been proved, however, in actual operation, that if a person lay down on the track in front of the car or fell sideways, it was impossible to save him. This had been the verdict on all fenders now in use. While one of the best advertised fenders in the United States was on trial recently in Cincinnati, a fatal accident resulted, and this was the very first day of its use. These facts had driven railway men to the opinion that the old reliable maxim of "stop, look and listen when crossing a street car track," was the most reliable life saver up to date.

Mr. McDonald is now preparing a report on the subject, giving all the details at his command, and his opinion is that a combination fender, which will unite the best points of the various ones now in use, will eventually be adopted.

Concerning street car systems, Mr. McDonald says that Montreal can justly claim to have one of the best in existence. Nowhere did he find a two-minute service as is given in Montreal. The nearest approach to it is in Boston, where they are running a two and one-half minute service on one route from 5 to 7 p.m. For the balance of the day in Boston nothing is closer than five minutes.

In every place Mr. McDonald visited, he found interesting and instructive details of maintenance and operating that might be profitably applied. The Boston subway is not only admirable as a well-planned monument of engineering skill, but it is also one of the greatest achievements in the science of operating cars and handling large crowds with safety and despatch. The arrangement of traffic on Brooklyn bridge was another example of the time that could be saved by proper facilities and a little hustling on the part of the people. The absence of grades in most large American cities afforded much more economical maintenance than could be shown with the heavy hills as in Montreal.

CANADIAN CAPITAL IN NEWFOUNDLAND.

Mr. R. G. Reid, of Montreal, who holds extensive franchises from the government of Newfoundland, has concluded arrangements for the immediate construction of an electric railway and lighting system in the city of St. Johns. The contract for all the electrical apparatus for the street railway, power and lighting plant has been awarded to Messrs. John Starr, Son & Co., of Halifax, who are agents in the Maritime provinces and Newfoundland for the Westinghouse Company. The generating station will have a capacity of 1,500 h.p., which will be transmitted eight miles to St. Johns, and there distributed from a sub-station. Step-up and step-down transformers will be used, the current being transmitted at 15,000 volts. The 500-volt direct current for the street railway will be derived from rotary converters. The contract for cars has been placed with Messrs. Lariviere, of Montreal, that for trucks with the Canada Switch Co., of same city, while the Stillwell-Bierce & Smith-Vaile Co., of Dayton, Ohio, will supply the hydraulic machinery. The first cars are to be delivered by August 1st.

SPARKS.

The Board of Trade of Three Rivers, Que., has set in motion a project for the building of an electric railway from that city to Grand Mere.

Berlin citizens are agitating for an extension of the present Berlin and Waterloo electric railway through German Mills, Doon and Blair to Galt.

At the annual meeting of the Hamilton, Ancaster & Brantford Electric Railway Company, held last month, the directors were re-elected. The company still requires $20,000 to make up the necessary capital of $60,000.

The employees of the London Street Railway Company are again on strike. It is probable that the question in dispute will be submitted to arbitration, the employees and the company having agreed to this course.

A bill to incorporate the Ontario & Quebec Bridge Company was thrown out by the Railway Committee of the Dominion Parliament. This was a bill to build a bridge from Bank street, Ottawa, to the city of Hull, so that the Hull Electric Railway Co. might carry passengers into Ottawa. The bill was opposed by the Ottawa Electric Company, which has a thirty year monopoly for an electric street railway in Ottawa.

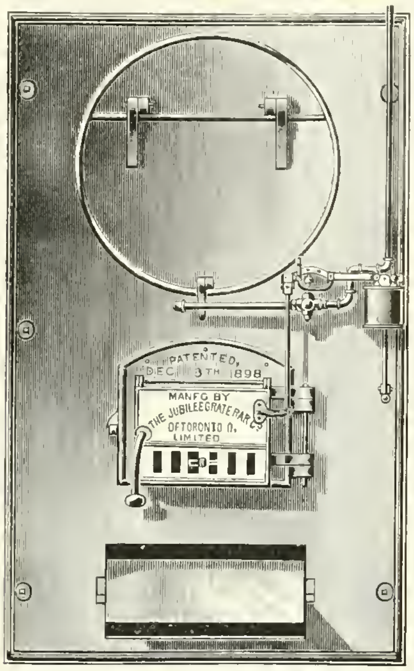
The Peterboro and Ashburnham Street Railway Co. have made a proposition that the corporation take possession of the railway, extend and improve it, and operate the road for a term of five years, without any allowance to the company, the understanding being that all capital expedinture shall be made with the concurrence of the owners, who shall have the right at any time within the period named to resume possession on repayment to the town of the sum expended on capital account, together with interest.

The Montreal Belt Line Railway Co. recently applied to the Railway Committee of the Dominion Government and to the Montreal council for permission to run its line from the north side of Duquette street to the Dominion Cotton Mills, within the limits of the city of Montreal. The Montreal Street Railway Co. protested on the ground that it had a right of preference over every other company, or in other words, that it held an exclusive franchise. The matter was referred to the city attorney, who has ruled that the corporation of Montreal, in giving the Montreal Street Railway rights and licenses, did not grant a monopoly for exclusive privileges. The city, he states, can grant the Montreal Belt Line Railway permission to run its line on Division street without violating the contract with the Montreal Street Railway Co.

Are you a member of the Canadian Electrical Association? It not, send in your application at once and take a hand in the forthcoming Convention at Hamilton.

THE REDPATH-REID AUTOMATIC SMOKE BURNER.

For a number of years engineers and mechanics in all parts of the world have been working diligently with a view to perfecting apparatus for consuming the smoke of boilers, and their efforts have in some instances been rewarded by a degree of success. This question has been given much attention by the patentees of the Redpath-Reid automatic smoke burner, who now claim to have perfected a machine which embodies all the elements which go to make up a high-grade invention, viz., efficiency, simplicity, and durability. Their smoke consumer is not a new system, but an old one improved and modernized.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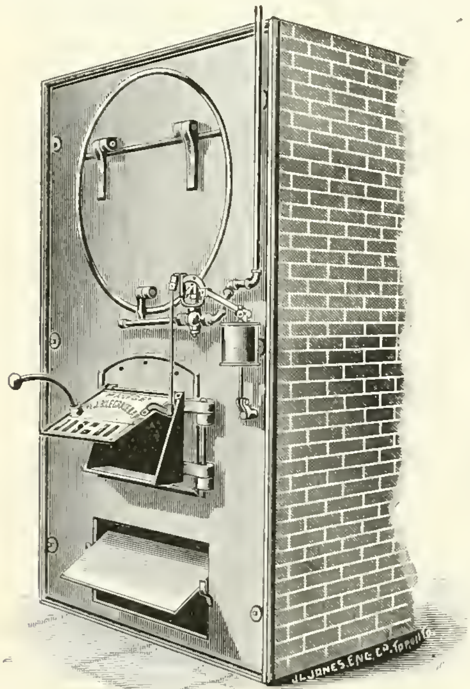
THE REDPATH-REID AUTOMATIC SMOKE BURNER.

Many persons will admit that the apparatus burns the smoke perfectly, but express a doubt when told that there is a saving in fuel of from 10 to 20 per cent. through the use of these consumers, contending that all the smoke that passes from the chimney would not warrant a tenth of this claim. The manufacturers of the Redpath-Reid burner offer the following facts to prove that the saving in fuel is effected: First, that it has always been impossible to otherwise get perfect combustion in burning coal. Second, that when there is perfect combustion, each pound of coal gives off 14,500 heat units, whereas with imperfect combustion not more than 4,600 heat units are likely to be obtained. Third, if all the smoke in the fire box is burned, the heat does not have to penetrate through from 1/32 to ¼ inch of non-conducting substance. Fourth, that invariably the greatest heat in the coal is near the grate bars, the top of the coal being coaked over and presenting a dull red glow until broken up. Fifth, some days the draught, owing to the state of the atmosphere or direction of the wind, may be very sluggish, and here again economy is sacrificed.


J.L. JONES ENG. CO. TORONTO

THE REDPATH-REID AUTOMATIC SMOKE BURNER IN OPERATION.

In using smoke consumers, it is possible to attain nearer to perfect combustion than in any other way, and a perfectly white blaze instead of unconsumed carbon passes through the tubes. The hottest fire is on top of the coal instead of under the surface, and the draught is always strong and cannot be effected in any way by the wind or atmosphere. A better understanding of the Redpath-Reid automatic smoke burner will be obtained by reference to the accompanying illustrations. The manufacturers are the Jubilee Grate Bar Co., of Toronto, who have already disposed of some provincial rights, and have others to sell for Quebec, New Brunswick and Nova Scotia.

THE IMPROVED SAMSON BATTERY.

The steadily growing demand for storage batteries is causing manufacturers to give much attention to perfecting improvements tending to increase their efficiency. We are advised by Messrs. John Starr, Son & Company that they have just made a change in the style of the well known Samson battery.

The improvement consists mainly in joining the carbon, zinc and cover in such a way that it is impossible, they claim, for a short circuit to occur between the elements when inside the jar. The cover is made of a hard dense material, into which is locked the carbon. The cylinder zinc is firmly held to the cover by a nut, and the result is, mechanically speaking, a one-piece battery which can be handled as such, thus dispensing with the rubber rings, etc., previously used. The carbon is held half an inch away from the bottom of the jar, and the zinc is a trifle shorter than the carbon. This is to save possible bridging of salts. The battery is shipped, set up, and to use same it is only necessary to remove the packing. The great advantage of this method, especially in the case of inexperienced persons using battery, will be recognized. It also faciliates the handling of same. The shape of the jar has also been altered, so that the whole appearance of the battery is very much improved.

Concerning the "Sampson" carbon the manufacturers say: It is manufactured in France and is composed of two parts, a fluted lower portion and a flat top carrying the binding post, which are baked into one piece in the kiln. The lower portion is a thin-walled, fluted, hollow cylinder, made from special materials, and by a special process, resulting in a quality of battery carbon which, as is the case with some natural products, cannot be obtained in this country. The top portion is composed of an entirely different kind of carbon from that used in the lower portion, which, after being subjected to enormous pressure, is treated when the carbon is complete in a way which renders it impervious to the creeping tendency of the solution and action of the ammonia gas.

The upper and lower portions, after being formed, are properly baked in the kiln, after which the top of the carbon is heated red hot and plunged into hot parafine, so that it enters into the minutest pore instead of simply collecting on the outside.

A combination of manganese and pea carbon is placed inside the fluted portion and held in position by a specially prepared plug which will not fall out. It is this depolarizer and its close proximity to the exceptionally porous carbon which imparts to the battery its remarkable recuperative qualities.

The result of the thorough and necessarily expensive mode of manufacture is the production of a battery carbon which has a larger surface, longer life and greater recuperative power than any other carbon element ever manufactured.

An improvement has also been made in the carbon binding post connections, which are bolted on across the top of the carbon, and is held in place by a safety check nut.

Messrs. John Starr, Son & Co. have recently appointed Mr. John Forman, of Montreal, agent for the provinces of Ontario and Quebec. Mr. Forman will carry a large stock of these batteries, and will be prepared to supply the trade promptly.

SPARKS.

The Bell Telephone Company is installing a municipal fire alarm system at Cowansville, Que.

A number of Peterboro' gentlemen are endeavoring to form a company to establish an automobile carriage service between Peterboro' and Chemong.

Mr. P. Alexander, electrician, of Peterboro', has recently completed the wiring for electric light of Geo. Matthews & Co.'s extensive establishment in that town.

The Town Council of Orillia, Ont., have submitted an offer for supplying light and power for the Asylum for Idiots, agreeing to put in a 750 light transformer and a 30 h.p. transformer for the sum of $1,400 per annum, on a five or ten years' contract.

Sales of small motors have lately been made by the United Electric Company, Toronto, as follows: 1 h.p. motor to E. S. Stephenson, St. John, N. B.; ½ h.p. motor to Brock Engraving Co., London; 3 h. p. motor to Lindsay Light, Heat & Power Co.

The Empire Heat and Light Co., of Westfield, N.B., is seeking incorporation, to deal in smoothing irons and all kinds of gas, electricity, and forces for power and heating purposes. The capital is $30,000, and the promoters are St. John citizens, including J. J. Porter and F. Calkin.

TRADE NOTES.

The Land Security Company of Toronto have ordered a motor for hoisting purposes from the Canadian General Electric Co.

The Canadian General Electric Company are installing a 100-light plant for the Beaver Portland Cement Company, of Montreal.

We regret to learn that the Ottawa Porcelain and Carbon Co. have decided to permanently close down their factories and liquidate their affairs, owing to the unprofitable results of the enterprise.

The Dominion Bridge Company, of Montreal, have placed an order with the Canadian General Electric Company for a G. E. 1,000 motor equipment, with special resistances, to be used for operating their heavy plate rolling machinery.

The Sprague Electric Company, of New York, have appointed Messrs. Jack & Robertson, of Montreal, Canadian sales agents for their well known electrical apparatus and supplies, including Lundell motors, generators, Greenfield interior conduits, etc.

Mr. F. S. Pearson, of New York, consulting engineer for the Cuban Electric Co., has awarded the contract for two 230 horse power engines to the Robb Engineering Co., of Amherst, N.S. They are for an electric railway from Regla, on the opposite side of the harbor from Havana, to Guamacoa, about eight miles distant.

Mr. Henry F. Duck, who for several years represented the Rathbun Company, of Deseronto, has been appointed Canadian agent for the Engineering Contract Company, of New York, and has opened offices in the Temple Building, Toronto. The company make a specialty of the construction of water power dams, foundations, canals, caissons, etc. Attention is directed to their announcement in our advertisement pages.

The United Electric Company, of Toronto, report the sale of 25 h.p. motors to the Schofield Woollen Company, Oshawa, and the Rat Portage Lumber Company, of Rat Portage. They have also sold an 80 h.p. generator to the Dominion Bridge Company, Lachine, Que., a 25 h.p. generator to John Bertram & Sons, Dundas, and a 60 light dynamo to the Journal Printing Company, Ottawa.

The Smart-Eby Machine Company, Limited, is the name of a new enterprise recently established at 191 Barton St. east, Hamilton. This company are engaged in the manufacture and sale of pumping machinery, steam, gas and gasoline engines, boilers, etc. Mr. Smart, who was a former resident of Hamilton, was recently connected with the Goldie & McCulloch Company, of Galt, and the Jenckes Machine Company, of Sherbrooke, and has therefore a practical knowledge of this business.

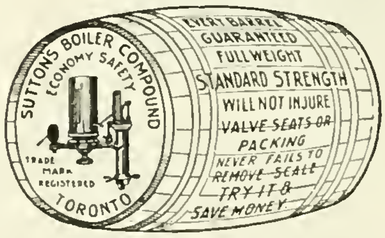
A very attractive catalogue has reached us from the Goldie & McCulloch Company, of Galt, Ont., descriptive of their "Model" gas and gasoline engine. A number of excellent illustrations are given, illustrative of the appearance and construction of the machine, accompanied by sketches showing the old fashioned method of obtaining power by means of windmills and such like antiquated devices. The catalogue is well designed to interest readers in modern methods of power development, and particularly in the advantages of the special engine to which the catalogue refers.

The Gasoline Engine Company has recently been incorporated and commenced business at Toronto Junction. The company have secured the right to manufacture in Canada the Olds gas and gasoline engines, which have been successfully manufactured and operated for some years in the United States. One of the members of the Canadian company was formerly connected with Olds Gas Engine Works Company, at Lansing, Mich., where these engines have, for some time past, been manufactured. The new company have therefore the benefit of practical experience in this line of manufacture.

The attention of young men who may be desirous of obtaining a knowledge of electricity and mechanical engineering is directed to the announcement in our advertisement pages of the Electrical Engineer Institute of Correspondence Instruction, of New York. This institute is designed to impart instruction in the above mentioned subjects by the correspondence method, which has been found to be a satisfactory substitute for attendance at engineering schools. Full information as to method, fees, etc., will be forwarded to any of our readers who may make request for the same, referring to the advertisement in the pages of this paper.

In a suit instituted by The Penberthy Injector Co., to restrain the Lee-Penberthy Manufacturing Co., of Detroit, from using the name Penberty, the Supreme Court of Michigan has decided in favor of the complainant, and ordered the latter company to discontinue the use of the name Penberthy in their corporate name and on their Lee injector. In compliance with this order, the defendants in the above suit advise us that in future they will carry on business as the Lee Injector Manufacturing Company. The decision will not interfere with any parties who have purchased Lee injectors in the past, the decree of the courts being that the word Penberthy must not be used in any form in the future.

SUTTON'S BOILER GOMPOUND



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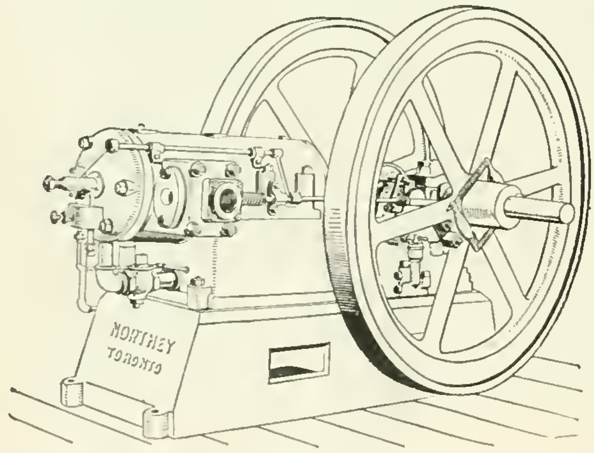

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CANADIAN

ELECTRICAL NEWS

AND

ENGINEERING JOURNAL.

VOL. IX. JULY, 1899 No. 7.

MEMBERS AND VISITORS, CANADIAN ELECTRICAL ASSOCIATION CONVENTION, HAMILTON, JUNE, 1899.

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AND
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ADVERTISEMENTS.

Advertising rates sent promptly on application. Orders for advertising should reach the office of publication not later than the 28th day of the month immediately preceding date of issue. Changes in advertisements will be made whenever desired, without cost to the advertiser, but to insure proper compliance with the instructions of the advertiser, requests for change should reach the office as early as the 26th day of the month.

SUBSCRIPTIONS.

The ELECTRICAL NEWS will be mailed to subscribers in the Dominion, or the United States, post free, for $1.00 per annum, 50 cents for six months. The price of subscription should be remitted by currency, registered letter, or postal order payable to C. H. Mortimer. Please do not send cheques on local banks unless 25 cents is added for cost of discount. Money sent in unregistered letters will be at senders' risk. Subscriptions from foreign countries embraced in the General Postal Union $1.50 per annum. Subscriptions are payable in advance. The paper will be discontinued at expiration of term paid for if so stipulated by the subscriber, but where no such understanding exists, will be continued until instructions to discontinue are received and all arrearages paid.

Subscribers may have the mailing address changed as often as desired. When ordering change, always give the old as well as the new address.

The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Secretary-Treasurer, R. T. MACKEEN, Halifax Tramway Co. - "

The Canadian Electrical Association.

THE ninth convention of this Association, held in Hamilton last month, was in every respect equal, and in some important particulars in advance of any previous meeting. The attendance was above the average, and was representative of the entire Dominion, from Charlottetown in the east to Vancouver in the west. The headquarters of the Association was the New Royal Hotel, which has recently been remodelled and fitted up in a style of elegance not surpassed by any hotel in Canada. The weather after the first day was all that could be desired, and permitted full enjoyment of the excursions to various points of interest in the locality. The greatest credit is due to the local electrical companies and the City Council for the many courtesies extended to the visitors, and also for the attractive manner in which the public buildings and parks were illuminated. On every hand there was manifest a desire to make the occasion one of the greatest interest and pleasure, and this desire was in the highest degree fulfilled. Hamilton on this occasion proved her right to the title of the Ambitious City, and also to claim the new title of the "Electrical City," in consequence of being the terminus of the Cataract Power Company's lines, which, as Mayor Teetzel mentioned in his address of welcome, transmit a larger amount of current over a longer distance than is delivered to any other city east of the Mississippi river. In the Hamilton, Grimsby & Beamsville Electric Railway, the city has also the longest suburban electric railway in the Dominion. Coming back to the convention, it can be stated that the business sessions were marked by a deeper interest than on previous occasions. The value of the papers presented is evidenced by the pointed and lengthy discussions. There was a time in the history of the Association when it was a difficult matter to provoke discussion, and when papers had in a measure to be taken as read, because of the timidity of members in giving expression to their opinions. That time has now gone by. The electrical industry has, during the lifetime of the Association, made rapid advancement, and members of the Association have kept pace with the development of the industry and feel their ability to express their views, based upon their experience on subjects arising for discussion. It is unfortunate that time would not permit of the reading and discussion of all papers prepared for this convention, and it will no doubt be found necessary for the future to restrict to a greater extent than formerly the number of papers, and to exercise the greatest care in the selection of subjects, in order that the discussions may bring out information of the greatest value. One of the most important points brought out in the discussions was relative to the supplying of current for power purposes to manufacturers during the hours of least demand for current for lighting. Mr. Gossler made the important declaration that in Montreal the day load for power purposes has reached 75 per cent. of the night load for lighting, and that in a very short time it is expected the day and night loads will be equalized. The valuable work done by the Legislation Committee in having the Conmee Bill placed on the Statute Books of Ontario was appropriately recognized. There was a disposition shown to make greater use of the Association to further in a practical way the interests of all branches of the electrical industry. Mr. W. H. Browne made an excellent presiding officer, and contributed from a large personal experience much valuable information to the subjects under discussion. Mr. A. A. Dion, the President-elect, has been for several years one of the most active and useful members of the Association. Under his direction, and assisted by an excellent staff of associates, the prosperity and usefulness of the organization must continue to advance. The city of Ottawa was unanimously selected as the place of next meeting. Many members of the Association have pleasant recollections of the convention held in that city five years ago, and the success achieved on that occasion is the best possible guarantee that the next convention will be one of the highest interest.

The Chambers Electric Co., Truro, N.S., are taking out two of their return tubular boilers, replacing them with a 150 horse power "Mumford Improved" boiler, manufactured by the Robb Engineering Co.

CANADIAN ELECTRICAL ASSOCIATION

PROCEEDINGS OF THE NINTH CONVENTION

THE Ninth Convention of the Canadian Electrical Association was held in the New Royal Hotel in the City of Hamilton, Ont., on Wednesday, Thursday and Friday, June 28th, 29th and 30th, 1899.

The opening session was held on Wednesday at 2 o'clock p.m., the President, Mr. W. H. Browne, of Montreal, occupying the chair.

The following members were registered as being in attendance :

J. A. Kammerer, J. J. Wright, A. E. Payne, E. B. Biggar, A. B. Smith, C. H. Mortimer, A. P. Horner, J. J. Ashworth, J. W. Campbell, T. R. Rosebrugh, A. Esling, A. M. Wickens, A. C. McDonald, Geo. F. Haworth, W. H. Warrington, A. D. McArthur, Joseph Rogers, W. McCaffrey, J. Milne, Ed. McCormack, Toronto ; P. G. Gossler, John Carroll, Wm. H. Browne, Alex. Barrie, W. J. Plews, F. H. Leonard, jr., C. H. Wright, Geo. H. Olney, D. W. McLaren, H. C. Ross, R. E. T. Pringle, Fred. Thomson, P. H. Hart, H. G. McLaren, C. A. Woolsley, E. A. Wallberg, Wm. T. Bonner, W. E. Gower, Montreal ; Geo. Black, W. A. Turbayne, Gordon J. Henderson, W. G. Angus, E. Irving, F. W. Martin, H. R. Leyden, J. B. Griffith, A. J. Nelles, C. K. Green, H. W. Woodman, Hamilton ; A. A. Dion, C. Thomson, W. Ahearn, jr., John Murphy, D. R. Street, W. W. Grant, Ormond Higman, Ottawa ; E. E. Cary, G. A. Powell, D. H. Henderson, J. Sangster, St. Catharines, Ont.; J. E. Bilger, W. F. Green, Berlin, Ont.; Geo. W. Shand, W. Williams, Sarnia, Ont.; J. F. H. Wyse, C. H. Waterous, Brantford, Ont.; John E. Gayfer, Stephen Noxon, Ingersoll, Ont.; B. F. Reesor, Geo. Sadler, Lindsay, Ont.; A. A. Wright, W. H. Mackay, Renfrew, Ont.; John Yule, Guelph, Ont.; H. O. Fisk, Peterboro, Ont.; Geo. C. Hinton, Vancouver, B.C.; P. H. Hover, New York City ; S. E. Fletcher, St. Johns, Que.; J. W. Purcell, Walkerville, Ont.; A. Sangster, Sherbrooke, Que.; L. A. Somers, Halifax, N.S.; Mark B. Thomas, Dundas, Ont.; James Anderson, Windsor, Ont.; John Phillip, Grand Valley, Ont.; J. Wardell, Charlottetown, P.E.I.

The President : Gentlemen, it is our pleasure to have our ninth convention opened by His Honor, the Mayor of the City of Hamilton, who was formerly connected with our industry and is here to offer us the courtesy of the city—His Honor, Mayor Teetzel. (Applause.)

Mayor Teetzel then addressed the convention as follows :

MR. PRESIDENT AND GENTLEMEN:—It affords me great pleasure on behalf of the city of Hamilton to welcome you to our city, and in doing so I do not think a more hearty welcome could be extended to any body of men than to the Canadian Electrical Association. I understand you did us the honor of holding your first convention here in 1892. Since that time great strides have been made in electrical discovery and invention. We are pleased especially at this period to welcome this Association here, for we feel in Hamilton almost as though perfection and completion of electric discovery had been attained ; that is the way it would appear to novices ; it would appear that it is almost impossible for further improvement to be made in electrical discovery and invention. We feel at the present time in Hamilton very proud of our position in connection with the science of electricity. We have, I believe, been christened the "electric city" by one of your periodicals, at any rate. We appreciate that suggestion, and I think it shall go forth from now on, that Hamilton is the electric city of Canada at any rate. (Applause.) We may not be—I trust we will not be—considered egotistical or conceited by claiming that we are the first city in Ontario, as far as electricity and the enterprises and developments that have been brought about in this particular science is concerned. There is no city, I understand, east of the Mississippi river to which so much power for such a great distance is conveyed as to the city of Hamilton. That is a distinction we are justly proud of. I understand there are cities west of the Mississippi that have conveyed to them for greater distances as much or greater power than we have in Hamilton, but I am credibly informed that there is no city on the continent east of the Mississippi river to which as much electrical energy is conveyed from such a distance as is conveyed to the city of Hamilton ; and I am delighted to say, sir, that it is to be credited to the enterprise and courage of the citizens of Hamilton that this result has been brought about. We also, I believe, have the proud distinction of being the first city in Ontario that adopted the arc light for public lighting by electricity. I believe Montreal was in advance of us, but if I am correctly informed, Hamilton was the first city in Ontario that took that departure, and I had the pleasure of being a member of the city council in the latter part of 1884 and the beginning of 1885 when that innovation was inaugurated, and I have never ceased to compliment the efforts of myself and the other members of the council to have inaugurated in Hamilton the system of arc lighting. I also believe Hamilton is the first city that had in actual operation, in Ontario at least, the electric railway system. I do not suppose you expect a speech from me to-day. I have been honored by an invitation to be present at your banquet to-morrow night, and I may have a few further remarks to make on that occasion. But I will say that in welcoming this Association to Hamilton, I do so, as I said before, most heartily ; I believe I could not welcome any Association of gentlemen more heartily, because I look upon the devotees of electrical science as a combination of men who have done more during the last quarter of a century to advance commerce, industry and civilization than any other body of men the world over. You have so reduced the size of the world. True, before the beginning of the last quarter of a century the size had been reduced, but during the last twenty-five years, by the application of electrical current to power, and by the telephone, communities have been brought together, industry has been stimulated, commerce has been advanced, and civilization has been advanced in consequence ; and I am proud to say also in that connection that to the names of Canadians perhaps to more than any other names can be attributed much of this great accomplishment. Edison and Bell and scores of other Canadians following down the line—the Thomsons, the Wrights, the Leydens, the Brownes, (applause) and a horde of other electricians, have contributed their quota to the perfection of the science. Gentlemen, I say nothing further on the present occasion than to repeat the welcome I have made, and I trust your stay in Hamilton may be pleasant and profitable. I am sure that our electrical friends here will do all they can to entertain you hospitably ; if they do not, I ask you to make any complaint to me, and I will endeavor to see any grievance properly adjusted. In the meantime, so far as I have the power and up till ten o'clock on each night, so long as you remain under the charge of my friends Leyden, Kammerer, Henderson, and my friend Wright, of Toronto, you shall have the freedom of the city of Hamilton (applause); and if you should be so bold as to stray beyond their protection that freedom will be withdrawn—not that I feel that you of your own inclination would go astray, but you might fall into the hands of those who might attempt to lead you astray. I again repeat, I wish you may have a very profitable and pleasant session, and that your deliberations will result in great good and in great profit to yourselves and to the advancement of the science to which you are devoted. (Applause).

The President: I will call upon our ex-President, Mr. Yule, to express the thanks of the Association to His Honor, Mayor Teetzel, for his kindly welcome.

Mr. Yule: I have much pleasure, Mr. Mayor, in tendering you the thanks of this Association for your hearty welcome, and I can guarantee the good behavior of all the members of our Association. I do not think it will be necessary for you to give any private intimation to the Chief of Police to see that we all get home in good time. We thank you most heartily for your kindly welcome, and we will do our best to enjoy ourselves while in the city of Hamilton.

President Browne addressed the convention as follows:

PRESIDENT'S ADDRESS.

GENTLEMEN:—Although in the declaration by the Constitution and By-laws of the general order of business to be followed, no place or time has been allotted nor provision made for such a procedure, yet it appears by the programme of events that the Committee have appointed that the convention, like the eight preceding it, shall begin with a President's address.

I would prefer to be governed by the prescribed formula of the Constitution, but as tradition and unwritten law frequently exert more control than written law, I must endeavor to emulate the good example given by my predecessors even if unable to hope to do more than emphasize by contrast the paucity of the suggestions which I may offer.

I will not undertake to occupy much of your time, because the committee have provided for our consideration a goodly array of good things. You will receive and hear read the reports of the several committees, and also that of the worthy Secretary-Treasurer recounting the condition and progress of the Association during the past year; and you will hear and discuss several very excellent papers when you find opportunity between the various events of hospitality provided in such prodigality by the local committee.

You will be particularly gratified by the report of the Committee on Legislation, through whose efforts was achieved the passage at the last session by the Ontario Legislature of an eminently just enactment having to do with the relations between municipalities and electric companies. The report of that committee will be accompanied by a copy of the enactment referred to, from which you will find that both municipalities and existing electric lighting interests are protected from unwise and hasty investment on the one hand, and from constantly impending danger of threatened annihilation of existing investments on the other hand.

The ninth convention of this Association is very appropriately held in the city where its first convention took place. Nowhere else could the extraordinary and rapid progress of electrical development be more emphatically demonstrated, nor the contrast with conditions existing only seven years ago be so sharply defined, than in this city of Hamilton. For here is tangible evidence in active daily operation of the furthermost advancement of the electrical art of to-day, in the distribution of the potential energy of Lake Erie throughout the city, dispelling its darkness and operating the machinery of its manufacturers.

At the first convention of this Association, held in this city only seven years ago, the probability of such a practical, commercially successful demonstration was considered to be in the far and remote future, as appears from the record of that convention. The transmission of energy a distance of thirty odd miles, as is the case here in Hamilton, was looked at doubtfully both from a physical and commercial standpoint. To-day no doubt exists as to the physical capability of transmitting and manipulating electric currents of high potentials long distances, for the varied uses of light, power, heating, chemistry and metallurgy.

The question no longer is, "Can we apply the electric current to this and to that purpose?" but "What new fields of enterprise can it enter and develop?"

This transformation in Hamilton took place shortly after the conclusion of the convention last year in Montreal. Since that time also has been put into operation a plant at Rossland, British Columbia, transmitting about the same amount of power the same distance as here. Many of you last year visited the works at Chambly, then under construction for the transmission of current to Montreal, and it is my pleasure to announce that the electric current has been transmitted from the power house on the Richelieu river, and the waters of Lake Champlain transformed into electric energy, flow throughout the city of Montreal. Such enterprises are so much the accepted fact and indicate successful physical accomplishment so thoroughly that many other similar enterprises, covering even greater distances, are being seriously considered by conservative capitalists, keen to perceive the great commercial advantages that will accrue from the developments made in this field of electric science.

Arising from the increased uses of water powers for the generation of electric energy, and the successful application of such energy to commercial motive power uses, a condition is beginning to assume shape with every indication of increasing, which may modify existing manufacturing conditions and perhaps change habits and methods of living. Its general adoption will result in the cheapening of motive power for manufacturers as well as reduce their costs otherwise, and also cheapen electric current for lighting.

I refer to the limitation of the use of electric current for manufacturers' motive power to the hours of daylight, or perhaps more properly speaking, to the time outside of those hours when the need of illumination makes the greatest demand upon the electric plant. A considerable objection to undertaking to seek motive power business has been the necessity of increased capital for plant in excess of lighting requirements to take care of the load which would exist during the hours when the motive power load and the lighting load would be called for simultaneously.

The idea has been maintained and acted upon that it is profitable for many, if not all manufacturers, to discontinue work as soon as the dark hours begin, for the reason that the cost of manufacturing is increased during such dark hours by the necessity of expense for illumination and by the diminished productive capability of the operatives. Besides avoiding these increased expenses, manufacturers can obtain the use of electric current for power, at a considerable reduction in price outside of the hours in which the greatest demand necessarily occurs for lighting. The cost of motive power to the manufacturer can be thus made much cheaper than he could otherwise produce it.

This additional source of revenue or increased return upon capital investment for plant and lines, will also enable the generator and distributor of electric current to sell such current for lighting profitably, at a less rate than when no revenue is derived from the plant in the day time. Less price for lighting will assist materially in the increased use of electric current for illuminating purposes. Since this idea was first suggested it has grown considerably, and its application is being gradually extended, and it does not seem too much to say that in a few years the hours of manufacturing will be restricted to the hours of daylight, with all the advantages that will result therefrom. While this condition is of the most value to the water power generation of electric current, it is of great value also to steam generation plant, by reason of the increased return upon invested capital which it will provide. The suggestion is well worth thoughtful consideration and furtherance.

In another direction also, the assembling of our convention in this city demonstrates the progress that has been made since the commencement of the career of the Association. At the first convention there were present 57 active and 24 associate members The total membership of the Association, by the report of the Secretary-Treasurer at the present time, is 241. This increase, continuous and progressive from the first convention, indicates not only lively and hearty appreciation of the advantages to be derived from association for mutual intercourse and improvement of knowledge from interchange of ideas, but also denotes continuous growth of electric interests and the progressive development of new enterprises.

Surveying the entire field of electrical industry in Canada to-day, it may be fairly said that if all are not in thoroughly sound and healthy condition, the greater number of them are prosperous and improving. In the days of the first convention, this could not be so well said, for as many of you, no doubt, remember, conditions were precarious and the probability of success uncertain. Here again I may allude to the result recently accomplished by our Committee on Legislation, which will greatly tend to advance such prosperity. Already it has had the effect of strengthening and fortifying existing enterprises, encouraging owners to endeavor to extend and increase their business, to enlarge and better their plants, because now they feel assurance that their investments are protected and that they cannot be deprived of them ruthlessly and recklessly. This is as it should be, not only from the point of view of the private owners of such enterprises, but from that of the general public and municipal interests.

Notwithstanding that the legislation referred to is so eminently fair, just and equitable, both to municipalities and to private interests, yet it is incumbent upon the members of this Association and upon all those having interest in electrical enterprises, to adopt systematic, prudential means of preventing retograde action in such legislation which may be aroused and agitated by persons of narrow and restricted views, who may undertake to procure alterations of the legislation referred to. It seems proper to suggest that all present members become actively interested to procure additional members for this Association throughout the Dominion; thereby to strengthen its capability for useful effort so that by unity of action procurable through the efforts of such enlarged organization, not only may the meritorious conditions obtained in this province of Ontario be maintained, but also be extended to the other provinces. To that end it is respectfully urged that every present member endeavor to add to the membership of this Association, thus to fortify and strengthen our committees in the furtherance of their efforts for the proper benefits that should accrue to capital invested in all electric enterprises.

The value of concerted action for mutual information and advantage may be illustrated in another direction by the following:

Many persons interested in electric lighting were solicitous as to the possible invasion of their business by acetylene. For the purpose of assembling authentic information as to the progress, present status and use of acetylene for domestic and commercial illumination, a circular was sent to cities, towns and villages throughout Canada having electric plants, requesting exact statements as to the conditions existing in those localities concerning its use and its interference with electric lighting. Replies were received from 103 localities. The results have been tabulated, and with some extracts from newspapers, will be presented in the proceedings of the convention so that every member will have accessible the fullest and latest information on that subject in convenient form. Here it seems sufficient to say that it may be concluded that no serious menace for the present, at least, need be anticipated therefrom to the electric lighting industry, although undoubtedly useful and profitable fields will be found for the desirable and proper use of acetylene.

The papers which will be presented and read at this convention will treat of matters of the highest practical importance, and I will not undertake to detain you longer from their consideration and discussion. They are of such character as to possess acute interest for all, and I solicit for them thorough and complete discussion to bring out any points not touched upon by the writers. The subjects selected are the results of suggestions received from many members in response to circular communication sent to the members some months since, and, therefore, may be considered to be your own selections.

With reference to these papers, on behalf of the committee having this matter in charge, I wish to say that they are particularly grateful to the writers who have accepted the requests of the committee. It is not always convenient, and probably it may be said, it is never convenient for a busy man especially (and it would seem as if most of us in this business are always busy), to find the necessary time to devote the concentration and thought necessary to the preparation of a paper that each writer considers he should, with justice to the Association and to himself, present for consideration.

I desire to express my regret at having been unable to devote as much time to the affairs of the Association as I should wish to have been able to do, but my regret is materially modified because the gentlemen of the various committees have so thoroughly attended to the matters entrusted to them, that the interests of the Association could not in any wise suffer by want of attention on my part. I therefore wish to extend my earnest thanks to the officers and members of committees associated with me, for their hearty co-operation, and to thank you, gentlemen of the Association, for the honor so cordially bestowed upon me in electing me president, and to bespeak for my successor the continuance of such hearty co-operation and enthusiastic support.

The address of the President was greeted with loud and prolonged applause.

The Secretary, Mr. C. H. Mortimer, read the minutes of the last annual convention, which were approved and adopted as read, as was also his annual report, as follows:

SECRETARY-TREASURER'S REPORT.

The most important work to engage the attention of the Association since last convention was the effort made, under the immediate direction of the Legislative Committee, to have such amendments made to the Municipal Act as would prevent the confiscation by municipalities of private capital invested in the electric lighting industry. It is gratifying to be able to report the success of the movement, which involved many meetings and much effort on the part of the committee and those associated with them. Particulars of this important work, which serves to establish the practical utility and usefulness of this Association as a means whereby the interests of its members may be conserved, are contained in the report of the Chairman of the Legislative Committee to the Association at this convention. It will no doubt be deemed advisable to provide means for safeguarding the rights which have been secured to electric lighting companies by the Conmee Bill.

The Executive Committee held three meetings during the year. At the first of these, held on September 9th, accounts in connection with last convention, amounting to $240, were passed; the additional sum of $50 was granted to assist the Entertainment Committee to discharge its obligations; the resignation of one member was accepted, and one new member was elected.

On March 23rd, the committee met to consider arrangements for this convention, and other business; a committee was appointed to make the necessary local arrangements, consisting of Messrs. George Black, H. R. Leyden, Gordon J. Henderson, E. E. Cary, Wilfred Phillips, A. B. Smith, together with the following gentlemen as honorary members: Messrs. Clyde Green, J. A. Nelles, Mark B. Thomas, J. B. Griffith, with power to add to their number. A committee to arrange for convention papers was appointed as follows: The President, Messrs. E. E. Cary, A. A. Dion, J. J. Wright, John Carroll, and the Secretary. Messrs. Cary and the Secretary were appointed a committee to procure badges and buttons for the use of officers and members attending the convention. The sum of $100 was voted to the Local Committee for entertainment purposes. The Secretary was directed to send out accounts to members for overdue fees, and to notify them that the names of members in arrears on the 1st of May would be struck from the roll. The Secretary was empowered to obtain the services of an assistant during the convention. Four persons were elected to active membership.

On the 20th of May, the committee met to receive the reports of the various sub-committees, and to complete arrangements for the convention. Five resignations were accepted, and two members elected. Accounts for convention buttons and printing, $23.05, were passed.

The number of new members elected since last report is as follows: Active, 20; associate, 2; total 22. During the same period there have been removed from the roll 14 active and 1 associate, leaving the present membership 241, or a gain of 7 over last report.

Several members in arrears for fees have objected to make payment, on the ground that they joined the Association for one year only. It should be clearly understood that when a person joins the Association, he is to be regarded as being a member until his formal resignation is placed with the Secretary. I would respectfully suggest that the form of application for membership be altered so as to conform to this view.

The receipts and disbursements have been as follows:

FINANCIAL REPORT FROM JUNE 1ST, 1898, TO 31ST MAY, 1899.

RECEIPTS.

Cash in bank, June 1st, 1898	$281.18	
Cash on hand, June 1st, 1898	19.46	
151 active members' fees at $3	453.00	
1 active member's fee at $3—paid $2	2.00	
22 associate members' fees at $2	44.00	
		$799.64

DISBURSEMENTS.

Expenses of convention		$435.14
Grant to local committee	$200.00	
E. J. Jenkins, stenographer	40.00	
Martel-Stewart (show cards)	5.00	
Convention buttons for 1898	64.64	
Electrical News, printing account	101.50	
Cuts for convention paper, and duty on cuts	20.49	
Express on parcels	2.08	
Telegrams	1.43	
	$435.14	
Grant to Secretary	$125.00	
Postage	46.18	
Express charges	.26	
Letter file	.40	
Telegrams	1.00	
Exchange on cheques	3.60	
Stationary and printing	19.95	
Buttons and badges for 1899	12.50	
Balance in bank	137.76	
Balance on hand	17.85	
		$799.64

RECEIPTS SINCE MAY 31ST, 1899.

Cash in bank, June 1st, 1899	$137.76	
Cash on hand, June 1st, 1899	17.85	
52 active members' fees at $3	156.00	
5 associate members' fees at $2	10.00	
		$321.61

DISBURSEMENTS.

Postage	$ 12.30	
Exchange on cheques	1.65	
Stationery	.55	
Cash in bank, June 27th, 1899	296.76	
Cash on hand, June 27th, 1899	10.35	
		$321.61

We have audited the Treasurer's account and find same to be correct.

H. R. LEYDEN.
GEO. BLACK.

The President: The next order of business is the reports of committees. I will call for the report of the Committee on Legislation first, and ask the Chairman, Mr. Yule, to read it.

REPORT OF COMMITTEE ON LEGISLATION.

Your Committee on Legislation beg leave to report that in compliance with motion passed at convention held at Montreal a year ago instructing them to continue their efforts to secure legislation in Ontario, the better to regulate the relations between electric light companies and municipalities, where the latter desired to enter upon municipal lighting, arrangements were made for the purpose of a united effort to put before the legislature the justice and merits of our views and the injustice of the law as it then stood.

A Bill was prepared by counsel, and after being submitted to your committee, was brought before the House, the result being, as you all know, that an Act was passed extending the provisions of the law regarding waterworks to lighting companies, providing for the transfer, upon fair conditions, of lighting plants to corporations, when they decide to enter upon the business of supplying electric light, and otherwise regulating the relations between municipalities and lighting companies on equitable terms.

Your committee held numerous meetings and gave the matter careful attention until what is now known as the "Conmee Bill" passed the legislature.

Your Committee do not intend, in this report, going into the details of their labor, but think it proper to inform you that the objections that had to be met and answered were of a popular and plausible nature and calculated to prejudice the minds of members until they fully understood the merits of the question.

The obstacles in the way of the Bill were increased by the hostile attitude of some of the newspapers, although the Committee are pleased to say that as the Bill became better understood, it received better treatment at the hands of the press.

Mr. James Conmee, M.P.P., West Algoma, took charge of the Bill, and the result proved it could not have fallen into abler hands. It only required a short time to convince your Committee that Mr. Conmee was fully alive to the justice of the general principle we were contending for. He had a practical knowledge of the merits of the questions at issue and the difficulties surrounding them. And what was of equal importance to us was that Mr. Conmee proved his ability to clearly, forcibly and intelligently explain the measure to his fellow members and to the House.

Mr. Conmee also introduced into the Bill, with your Committee's concurrence, various provisions to adopt such suggestions as were of value and which he considered were salutary amendments in the public interest

Your Committee admired the patience and tact with which Mr. Conmee, on different occasions, met and discussed the matter with them and also with the opponents of the bill.

Your Committee retained, as parliamentary counsel for the Bill, Mr. Donald Guthrie, Q.C., Guelph, who drafted the Bill, and during the progress of the work he was assisted by Mr. W. D. McPherson and Mr. Edward Bayly, barristers, Toronto, Mr. Gauld, barrister, Hamilton, and Mr. Pepler, of Barrie. The measure was also supported by a number of legal gentlemen retained by different lighting companies; influential deputations from different parts of the province also attended in Toronto to assist your Committee.

The arduous and exacting work for quite a time, when the outlook was very unpromising, added largely to the expenses of your Committee, but they are pleased to be able to say that all accounts have been paid in full.

About fifty companies contributed to the expense fund, a statement of which is appended. In this connection your Committee desire to convey to the Royal Electric Company, Montreal, and the Packard Electric Company, St. Catharines, their hearty thanks for unsolicited and substantial contributions received from them.

The management of these companies recognized in a practical form that the stability of the lighting companies was of vital interest to them.

Before passing from the Conmee Bill your Committee desire to point out two important provisions in that Act:

First.—The clause providing for corporations having the right to get contract price for street lighting fixed by arbitration, where parties fail to agree, thus removing the complaint that lighting companies could make municipalities pay an unreasonable price because of there being no competition.

Second.—The provision made for having prices charged to citizens fixed in the same manner. These clauses very materially extend the powers and rights of municipalities.

At the last meeting of your Committee the policy to be recommended to our successors in office was discussed, and it appeared to be the opinion that while there was no probability of the principle of the "Conmee Bill" being repealed, there may be efforts made to get amendments passed that would endanger the fair working of the Act.

They would respectfully recommend that some arrangement should be made to give attention to all measures introduced in which lighting companies are interested.

For this purpose, your Committee consider it would be an economical policy for the companies to enter into an agreement, for say five years, to pay a small annual subscription to cover the expense of legal services for this purpose. The reason for suggesting the term of years is, that spasmodic and hurried efforts to raise necessary funds use up too much time and attention of your officials and members of Committee.

The members of this Committee, and in fact of all Committees, pay their own travelling and other expenses, and are of opinion thatthe lighting companies should not hesitate to provide them with the necessary funds to cover cost of services that have to be paid for and that are required in matters of this kind.

The foregoing is merely an expression of opinion on the part of your Committee, the result of two years' experience in actively attending to the interests of lighting companies.

JOHN YULE,
Chairman Committee on Legislation.

Dated 28th June, 1899.

ABSTRACT OF FINANCIAL STATEMENT.

Balance from 1897-98	$ 147.44
Subscriptions paid 1899	1,955.00
Total	$2,102.44
Paid for legal services	$1,854.87
Paid for office assistance, telegrams and telegraph messages, postage, stationery, printing and exchange on drafts	171.90
Balance on hand	75.67
Total	$2,102.44

The following were the contributors to the expense fund for 1899: Royal Electric Company, Montreal; Packard Electric Company, St. Catharines; W. A. MacKay, Renfrew; A. A. Wright, Renfrew; Arnprior Electric Light & Power Company; Brockville Light & Power Company; Smiths Falls Electric Light Company; Lindsay Light, Heat & Power Company; Owen Sound Electric & Illuminating Company; Bowmanville Electric Light Company; R. A. Corbett, Port Hope; Guelph Light & Power Company; Ottawa Electric Company; Sarnia Gas Company; Galt Gas Company; Cataract Power Company, Hamilton; Almonte Electric Light Company; Pembroke Electric Company; St. Thomas Gas Company; St. Catharines Electric Light Company; London Electric Company; Exeter Electric Light & Power Company; Strathroy Electric Company; Joseph Knox, Stayner; O. Higman, Ottawa; John Phillip, Grand Valley; Welland Electric Light Company; Willson & Sons, Meaford; A. M. Merkley, Morrisburg; Wm. Snider, Waterloo; R. P. Bearman, Chesley; Midland Electric Company; Perth Electric Light Company; Aylmer Electric Company; Toronto Electric Light Company; Madill Bros., Lakefield; L. H. Reesor, St. Marys; Parry Sound Electric Light Company; Hamilton & Prout, Forrest; Stormont Electric Light Company, Cornwall; Gananoque Electric Light Company; Citizens' Telephone & Electric Company, Rat Portage; Corley & Collins, Mount Forest; Gravenhurst Electric Light Company; J. A. Spence, Colborne; Robertson, Rowland & Company, Walkerton; Berlin Gas Company; Cobourg Electric Light & Power Company; Isaac P. Wiser, Prescott; Wingham Electric Light Company; Woodstock Electric Light Company.

The amounts contributed were as follows:

1	contributor	paid	$250
2	"	" $200 each	400
5	"	" $100 "	500
1	"	"	75
5	"	" $50 each	250
1	"	"	30
7	"	" $25 each	175
3	"	" $20 "	60
4	"	" $15 "	60
9	"	" $10 "	90
13	"	" $ 5 "	65
		Total	$1,955

Mr. A. A. Dion: I have much pleasure in moving that the report which has just been read be received, and that the thanks of this Association be tendered to Mr. John Yule and the members of the Legislative Committee. The amount of work performed by these men during the last two years in connection with the legislation which has been obtained has been enormous, and their zeal is beyond all praise. The manner in which they handled this question calls for congratulation from the members of this Association, and certainly we cannot say too much in thanks and gratefulness for their devotion to a question which affects our best interests, and in obtaining legislation which will be a lasting benefit to the members of this Association.

Mr. J. W. Purcell: I take pleasure in seconding that motion. I think with Mr. Dion that the Legislative Committee have had a great deal of work which the members know nothing of, and they have had more work than it was thought they would have at the time they were appointed.

The President: I am in hearty accord with the motion which has been regularly moved and seconded, and before I put it I would like to hear expressions of opinion from any other members of the Association here. I think it is entirely due to the committee that as many members of the Association present as possible should, in their own way, express their commendation of the efforts and of the result of the efforts of this committee. There will be, undoubtedly, proper time to-morrow to consider and discuss the main suggestion of this report—that is, the agreement on the part of the companies in the Association or out of it to organize for a period of years and to agree to pay a small sum annually towards meeting the necessary expenses of this committee. I will be pleased now to hear any expressions of opinion.

Mr. H. R. Leyden: I want to say a few words in connection with this matter, and I want to express what I think ought to be the opinion of the Association in respect to Mr. Yule's personal connection with this. I know, from the small connection I had with this legislation, that Mr. Yule devoted the principal part of two months to this bill; and I also know that he was in Toronto for two whole weeks doing nothing else but working on this bill. There were also a number of other gentlemen, most of them members of the committee, who labored incessantly during the meeting of Parliament in Toronto to further this measure, and I do not think the members of this Association can go too far in any direction in expressing their gratitude to the members of this committee. I also think that the Association should, in some way, show their appreciation of the personal labors of Mr. Conmee in regard to this bill. I do not think I am going too far in saying that if it had not been for Mr. Conmee's personal energy that we would have had very grave difficulty in getting this bill passed. Mr. Conmee entered into this measure with all the enthusiasm of a man with a large amount of money invested in electrical interests; he took the greatest pains and the greatest patience in explaining the details and justice of the Bill to the different members. As far as the Bill itself is concerned, I think there is one point in particular that wants to be emphasized to the members of this Association, and that is the principle of arbitration which is now embodied in the electrical interests of Ontario. All public corporations in dealing with the public are subject to various unjust claims and demands. The electric lighting industry now is placed on a basis whereby through arbitration they can obtain what is right and fair, and on the other hand municipalities through arbitration can obtain what is right and fair. This principle of arbitration, by being applied to electrical interests, is going to do more, I think, for the interests of electrical companies in a fair way than anything else we could do. Just take an instance of it; this Bill provides specifically that in cases where the municipality and supply company cannot agree upon the price, that it shall be arbitrated; that arbitration will undoubtedly be on a fair basis and give the electric lighting company a fair return for their light. On the other hand, for private lighting, how much they shall charge is also to be subject to arbitration. If the municipalities can obtain a fair service at a fair rate, there is no call for competition of any kind. There are a great many places, in England particularly, where this principle of arbitration is carried to such an extent that they give the illuminating company a certain territory and give them the exclusive right of lighting in that territory, the only provision being that they shall give a good service and at a reasonable rate, which rate is subject to arbitration. Now, if that principle of arbitration is carried to its proper extent, the electric lighting companies, as long as they do what is fair, will enter on an assured era of arbitration. That principle of arbitration, to my mind, is one of the most valuable features of that bill.

The President : Mr. Leyden has undoubtedly struck the key note of this entire legislation, that is, the principle that investors in any enterprise of a semi-public nature will be entirely satisfied with a fair and proper return upon their investment so long as they are assured of non-interference—so long as they can be assured that when they give fair service and fair rates their investment is secure, and that principle being established by this act of legislation, it would seem, as it were, utterly impossible, if we give the matter any attention at all, that it should ever be taken off the statute books. Now, gentlemen, the motion is before you, and I ask for your approval thereof.

The motion was carried amid applause.

The President : The next committee to be heard from is the committee having to do with the Board of Fire Underwriters ; I will ask Mr. Gossler to read the report.

Mr. P. G. Gossler read the report of the committee appointed to interview the Board of Fire Underwriters, as follows :

REPORT OF COMMITTEE TO INTERVIEW FIRE UNDERWRITERS.

To the President of the Canadian Electrical Association.

Your Committee, appointed at the convention of 1898 of this Association, for the purpose of interviewing the Quebec Board of Fire Underwriters with regard to the adoption of permanent rules governing electrical installations and means of enforcing compliance with the same, beg to report that they had several interviews with the secretary and with a special committee of the underwriters. The question of rules and inspection was thoroughly discussed, but no understanding towards the establishment by the underwriters of a regular and efficient system of inspection was arrived at. It was held by the underwriters that such a system of inspection, even if it covered only the principal cities of Canada, would involve a much larger expenditure than they felt called upon to undertake. They had provided rules for electrical installations, and they considered that the electric companies and the municipalities should in their own interest see that these rules are carried out. Your committee would recommend that a committee be appointed at this convention to continue the work, and endeavor to have established some efficient system of inspection, independent of and apart from the electric companies, for the protection of our own interests as well as those of the underwriters.

(Signed) P. G. GOSSLER.
A. A. DION.

Mr. Gossler : in connection with this report I wish to say that while it is short and does not seem to have involved much labor, there has been considerable work done. I have, on several occasions, in company with Mr. Dion, of Ottawa, interviewed Mr. Hadrill, secretary of the Quebec Board of Fire Underwriters. They gave us no encouragement whatever to establish a system whereby the fire underwriters would be called upon to be at any expense ; they maintained that the proper way of establishing a system should be by municipalities enacting by-laws whereby the buildings and building laws would enforce compliance with the Board of Underwriters' rules as at present universally adopted. I may say that there was very little encouragement given to the committee at all, because the fire underwriters did not seem to think the fire hazards due to electric wiring were such as to warrant them going to any expense. We called to their attention the fact that the fire underwriters of other large cities had seen fit to go to this expense ; but I presume they thought they would profit by their own experience rather than offer any suggestion whatever for the establishment of an inspection system. I might say on this committee was Mr. George W. Sadler, of Montreal, who at the time of his appointment, was and is at present a member of the city council of Montreal. He is also a member of a special committee on building rules of Montreal, appointed with a view of having rules made by the council embodied in the building association rules, to enforce the established rules for electrical installations. Mr. Sadler is unable to be present, and wrote me a letter which he wished to have read in connection with this report, which is as follows:

DEAR SIR : At the last moment I find it is impossible for me to attend the ninth convention of the Canadian Electrical Association. There is no doubt but you are prepared to make a report to the Convention of the doings of the committee to confer with the insurance and the city of Montreal re the wiring of buildings. My appointment on that Committee was largely owing to my position as a member of the City Council of Montreal. I would like to say that I have found it impossible to do anything in the matter since our last meeting, the reason being that a great deal of time has been consumed in getting amendments to the Charter, and nothing could be done in connection with the by-laws until the Charter had passed the Council. Since then the various committees have had the by-laws under consideration, but very little progress has been made. I stated at the last convention that the city of Montreal has a very good new building by-law prepared, and I had hoped to have it sent up for discussion in the council ; this opportunity has not presented itself yet, and it may be a month or two before the committee will report to the council.

If the Convention decides to keep the committee on this subject standing, I will be very pleased to still act with them, and do all I can to further the interest of all concerned when the opportunity presents itself.

Please convey my kind regards to the officers of the Association, and I trust that the ninth Convention of the Electrical Association will be a profitable and pleasant one to all members.

Yours very truly,
GEO. W. SADLER.

Mr. A. A. Dion : Before any action is taken upon this report, as a member of that committee, I wish to refer to a matter which this report brings to mind—it is a fact that among the members of that committee was a man who was for many years a useful and active member of this Association, and who has been carried off by death since the last meeting of this Association. I think it is a duty, though a sad one, to register in the minutes of this meeting the regrets of the Association at the untimely death of Mr. F. H. Badger, jr.

The Secretary : In connection with the remarks just made by Mr. Dion, it will have been noticed that Captain Williams, who was electric light inspector for the London district, a respected member of this Association, and a respected citizen of the city of London, has passed away within the last two or three days.

The President : The regrets of the Association will be duly recorded in the minutes of the proceedings. In reference to the report of the committee just read, while the results achieved by them are not as successful as of the Committee on Legislation, it seems that they have begun in the right direction, and while the Board of Fire Underwriters may be obstinate, the very suggestion that some method can be adopted in building laws to procure the supervision by the proper authorities of the wiring seems to point to the fact that we may ultimately accomplish the same end, and I would suggest that the Association approve of the continuance of this committee in the hope that they may be able to have incorporated in the municipal laws the adoption of some uniform plan which will be final in its action.

On motion the report of the committee was approved.

The President called for the report of the Committee on Statistics.

Mr. J. A. Kammerer read the report of the Committee on Statistics, as follows :

REPORT OF COMMITTEE ON STATISTICS.

GENTLEMEN,—As chairman of the Statistical Committee, I beg to report that we have gathered a large quantity of information and data about the electrical industries in Canada, but have not been able to get quite all that we wanted. It was perhaps a mistake on the committee's part in starting out to make the scope of the report too wide, but I can assure you that when the report is presented it will be of some value. In view of this, I would ask that the Statistical Committee be continued for another year with the same personnel, or others whom you see fit to appoint. The data and information which we have gathered will be at their service.

Respectfully submitted,
(Signed) J. A. KAMMERER,
Chairman Statistical Committee.

Mr. Kammerer : In connection with this report, I would like to say, Mr. President, that we found in all the data that we have got, especially as to prices of lighting, that our station managers seem to have the prices in a transitory stage—they are not settled. The tendency seems to be that they want a little more money for what they are furnishing, and they are trying to find out which way they can make more; and for that reason, more than any other, the report could not be completed. It would only be a half report, and I thought it best not to make a half report when, no doubt, we could make a full and complete one later.

On motion the report as read was approved.

The President called for the report of the Committee on Meter Inspection.

Mr. J. J. Wright: That committee has had no meetings during the past year. There have been no measures taken in regard to the inspection of meters by the government that would necessitate the calling together of the members of that committee.

The President: That would appear to be all the reports. The next order of business is General Business.

Mr. A. A. Dion: There may be no other opportunity of bringing up a question which is suggested by Mr. Wright's report, and it is this: We as a company in Ottawa propose to take up with the Inspection Department the question of the possibility of making such departmental regulations as would allow of meter seals being broken for cleaning and adjusting the meters without paying an extra fee. As the law is at present, you are aware that meters have to be inspected every five years. There are not a great many meters that will run for five years without some adjustment or cleaning, and this cannot be done under the present regulations without breaking the seal and paying an additional fee. I take it that the intention of the government is not to compel companies to pay for meter inspection more than once in five years for each meter in service; therefore it is a proper question to ask them if some regulation cannot be made whereby the privilege of breaking seals will be allowed under certain restrictions. The question arises whether this Association should not take this matter up; possibly the Committee on Meter Inspection might be continued with the hope of taking this question up during the present year. I think it is one of considerable importance. The cost of meter inspection is quite a large item to some of the companies, and having to pay extra fees makes it still greater. Mr. Wright no doubt has had considerable experience in using meters in large numbers, and he can probably see the value of the suggestion.

The President: It appears that the programme of part of the proceedings to-morrow will be the election of the standing committees, which will undoubtedly result in the continuance of the committees that have been already approved of, and thus accomplish the purpose Mr. Dion has suggested. Under the head of general business I am desired to say on behalf of the manager of the Hamilton and Dundas railroad that at five o'clock this afternoon he will be pleased to give the pleasure of a trip on that road to any and all of the members of the Association who may desire to participate. I presume that you will be able to enjoy this and be back in sufficient time to also enjoy the trip arranged for this evening at half past seven, as appears by the programme, to Burlington Beach, by courtesy of the Hamilton Radial railway and the Hamilton street railway. Another topic of general business, the Executive Committee at its session this morning thought it advisable to endeavor to crystallize or make deliberate the action of the Association in making nominations for the officers for the incoming year. Without undertaking to in any way restrict the individual action of the members of the Association, but simply for the purpose of exercising a deliberation and offering suggestions, it was desired that I would appoint a nominating committee. The election, as you are aware does not take place until Friday, but I will now announce the nominating committee who will take the matter in hand and present for our consideration to-morrow the names of the gentlemen whom they offer for your suffrages on Friday morning. As I stated before, this will not prevent any and all members of the Association from making nominations on their own account in contradistinction to the nominations offered by the committee. I now appoint as the nominating committee Mr. Cary, Mr. Carroll, Mr. J. J. Wright, Mr. Yule and Mr. Wyse, and I commend to their kind and early consideration the adoption of a ticket that I trust will meet with the universal approval of the members and will not call for any opposing nominations.

Mr. John Yule: Do I understand that this committee will nominate the members of the standing committees?

The President: No; they will nominate the members of the Executive Committee, and the gentlemen up for the offices of president, first vice-president and second vice-president.

Mr. J. Yule: Hasn't it been the practice heretofore for the President to nominate a small committee to confer in the nomination of the standing committees?

The President: That, I understand, is the action to be taken to-morrow. I may be incorrect about it, but there seems to be no provision made for any other method in the programme. I am entirely willing, Mr. Yule, to leave to this committee the selection of the standing committees for the year. If they are good enough to select the candidates for offices, they will be good enough to do that. I understand it is in the nature of an advisory board to the President in appointing the standing committees.

Mr. Yule: I think you will find the committee to nominate the standing committees was always nominated the first afternoon and reported the next day.

The President: Very well; I will entrust that to this same committee.

Mr. J. J. Wright: When is this committee to report?

The President: To-morrow; preferably as early as possible.

The President read two communications, one from C. S. Cochran, photographer, and the other from Mr. G. A. Browne, traffic manager of the Richelieu & Ontario Navigation Company.

The President: Has any member anything of general business purpose to offer for consideration now? (No response.) There being none, the next order of business is the presentation of papers. I will call upon Mr. A. A. Dion to read his paper entitled "Meters and Meter Rates." You all have copies. You will find it is exhaustive and enters into the question fully, and I hope and solicit most earnestly that, as the reading progresses, you will all make notes and bring up matters for discussion. Let us have all the papers fully discussed. I am sure that the writers of papers will feel no injury to their feelings whatever in having all sorts of discussion brought out in order to make clear to ourselves and perhaps to assist them in a further exposition of their subject.

Mr. A. A. Dion, of Ottawa, read his paper entitled "Meters and Meter Rates," which is printed on page 156.

The President: I think, gentlemen, that the Association can take exception to the last paragraph of Mr. Dion's paper in which he intimates that he has not treated satisfactorily this subject. I think in that we must disagree with him. But there is much in this paper which, while coinciding with the experience of many of us in almost every particular, ought to arouse a great amount, not of discussion in the sense that it may mean objection to what is said, but for the purpose of reinforcing what Mr. Dion has said in many particulars, and I think if I call upon Mr. Gossler, who is quite familiar with the system in Montreal and what our practice there is, it may assist in promoting further talk on the matter.

Mr. P. G. Gossler: Mr. President, before the convention comes to discuss that part of Mr. Dion's paper relating to meter rates, which I presume is by far the most interesting part of the paper to us all, there are several points in connection with testing meters which I should like to bring up for discussion for my own information. I first refer to that part of Mr. Dion's paper under the head of "meter room," where he says "The meters should be connected in series, and the circuit, which must be of large wire, should pass through a main switch and cutout, a rheostat or choking coil to adjust the voltage." It has been the result of our experience and some exhaustive tests to determine the characteristics of the meters we have in use, mainly Schallenberger meters, that testing meters in series introduces an inductive load; that is, the coils of the meters themselves introduce a lagging current and there is an inductive load, and we find the meters run fast; consequently, the meters for proper adjustment will be adjusted to run slower. When I say they run fast, I mean when compared with what they will run on a non-inductive load such as a lamp load. This may not be detected if the meters are placed on customers' premises and then brought in and tested in the same way, but I am positive if Mr. Dion has placed his meters in series in testing them and adjusting them in series, with an extra inductive load, on a choking coil, that he will find them running considerably slower on the customers' premises. But if anyone else has had that same experience I would like to have it confirmed, because I have made rather a positive statement. There is another statement where Mr. Dion says that he has obtained very satisfactory results with only ordinary care with the Schallenberger meter. That has not been the result of our experience; we have found a great deal of care is necessary in all such meters. We found that merely placing the meter on the floor in a great many cases injured the steel pinion or pivot and also in many cases cracked the jewel. As to the statement that meters will not start with less than three per cent. of load, I am happy to say that day has gone by, because we have in use meters that will start with two-tenths of one per cent. of their load. I am confining my remarks now entirely to the testing of meters. The statement that meters will run slow on light loads is also modified by the results of our experience with meters and light loads. We have had two meters calibrated to run identical on three-quarters of the full load, and we have found one meter to run very slow on a quarter load, and the other meter to run possibly five per cent. fast on a quarter load, so that the registration of the meter under half load is entirely dependent upon the friction of the jewel. The number of lights that Mr. Dion has stated, that the Schallenberger meter will start upon, often applies to meters that are comparatively new, but after they have been in use for some time we find it takes a considerably larger number of lamps than is stated. I would like further to discuss the matter of meter rates when it comes up, but I will defer that until later.

The President: Mr. Gossler appears to agree with Mr. Dion that this subject should have been divided into two parts, for he has confined his remarks to the question of testing meters only. We will adopt the suggestion of the two gentlemen and ask for other remarks upon the matter of meters and meter testing before we take up the question of meter rates.

H. O. Fisk: I may say I have devoted considerable time to accounts of the recording watt meter, more especially of the old type. We have quite a number of meters that were made some years ago and we find they run slow under light loads, as has been stated by Mr. Dion. I have devoted considerable time to find if these meters could be brought up to date; that is, made to run accurately on light loads; and I find by putting an auxiliary coil to run with the field, that is, taking part of the shunt that acts as resistance in series with the armature and winding that so as to work with the field that it will increase it just enough, that is if the coil is proportioned right, to eliminate the friction. When you have arrived at that point your meter will run on a very light load; in fact on a 50 light meter I have got 55 watts out of 60; that is not taking a master meter, but taking an indicating watt meter and a stop watch, and having the voltage and everything as perfect as it is possible to have it. We find it a great advantage to make an accurate record of all meters we put in, especially when they are new, and when they are tested. We do not test them just as the government prescribes; we test them on one, two, three, five and ten lamps,—that is for an ordinary ten light meter,—and more for a larger meter. These tests are recorded and kept in a book. We find a customer will come in and kick about his meter being outrageous, and just by showing him this record that was made before the meter was sealed, it settles the whole trouble. We find it a very fine thing to keep a record of that kind. But, the auxiliary coil, as I mentioned before, for old meters, is a fine thing. Take a meter even with a dirty commutator, that auxiliary coil can be made to make that meter strong enough without cleaning the commutator.

J. F. H. Wyse: Don't you ever find that the auxiliary coil makes it run without any load on it.

Mr. Fisk: We put as much as 100 ohms of No. 30 wire right on the field and that adds to the resistance in series with the armature and also eliminates the friction. It not only works out in theory, but it is also borne out by practice. I have tried it.

A. A. Wright: Deriving our revenue almost entirely from meters, we ought know more about meters than we do. I quite agree with Mr. Dion that a meter room should be provided for the testing of these meters and cleaning them, and so on. There are one or two questions I would like to ask Mr. Dion. I don't exactly understand how he keeps his record. He says that there should be a day book and entries made in the day book, and these posted into the ledger. Providing, we will say, you are installing a meter in a house for Mr. Brown, what entry would you first make in the day book, and how would you enter it?

Mr Dion: Mr. President, the entry in the day book would be a record of what was done—"the meter so-and-so, say 20 amperes, Schallenberger, installed at Mr. Brown's house, such a number, such a street." That will be the entry in the day book. Then supposing the meter was No. 20,515, he would turn to the page bearing the same number as the meter in the ledger. There will not be in the ledger a page numbered 20,515, but there will be a page headed with the same number as the serial number of that meter, and in that page you will enter that that particular meter was put in Mr. Brown's house. So that if you come across this particular meter a year after and you want to know the history of it, you turn to that page and you find it was tested on such a date and put in Mr. Brown's house; it was taken out six months after and tested a second time and put in Mr. Smith's house, and so on; the whole history of it will be there. The principal value of the entry is to show the different tests that have been made on that particular meter. It involves some work, but it is of some value.

A. A. Wright: Supposing you wanted to turn to meter No. 2,753, do you have an index?

Mr. Dion: We have to have an index, or else enter your numbers in consecutive order.

Mr. A. A. Wright: You mention with reference to a man taking the readings when he goes around; does the man that takes the readings put it right down in the book himself?

Mr. Dion: No.

A. A. Wright: I know in our case, we have a book with the face of the meter right on it; we have January, February, March and April on one side of the book, and then on the other side, right opposite, we have May, June, July, August, September, October, November and December; there are more months on one side than on the other. At the head of this, we have the name of the party, when his meter was installed, the style of the meter, the number of the meter and everything in connection with it, the day it was installed, and the number of lights that the customer has. We have for every month the meter right before us; and when you are taking the reading, after the man has put down the location in the index, you can tell whether he is reading the meter correctly or not.

Mr. Dion: Do you mean he carries that book with him?

Mr. A. A. Wright: He carries that book with him every month.

Mr. Dion: I don't think that would be practicable with us. The readers think their book is large enough as it is.

Mr. A. A. Wright: It is practicable enough; if you have too large a book you can have a number of books.

P. G. Gossler: I think you will find with most meters that are used that the serial numbers of meters, especially the Schallenberger meter, are up in the several hundreds of thousands and you cannot index them, neither can you locate them by the man's name on whose premises they are placed, because they may be changed several times a year. We have invented a card catalogue, and find it very satisfactory.

A. A. Wright: I know nothing about the Schallenberger meter.

The President: The same idea will apply to any make of meter, because their numbers are increasing all the time, and indexing by the number of the meter will become somewhat difficult; it is well enough in the case of a small number of meters. But the card system will locate any meter at any time, and the history of that meter may be recorded on the card catalogue as forming the ledger referred to by Mr. Dion. It takes the place of a page in a book in which you recite the number of the meter, the date on which you receive it, the date on which you test it, the date on which you placed it in the customer's premises, the date on which you removed it from the customer's premises, the date on which you test it again, and the day on which you place it in another customer's premises, and so on; in other words, it is the life history of that meter.

A. A. Wright: I have no doubt that would be a very advantageous way to do it, and of course we are very thankful to receive pointers in that way. I quite agree with Mr. Dion with reference to the installing of small meters instead of large ones, that it is very much better to install them on the small than on the large side, because it works better to the station owner. He suggests the reading of meters once in three months. I don't know, I am sure, how it would work in some places; I know it causes a good deal of work, but I have always been under the impression that reading them monthly is the better way; it saves a great deal of trouble and you don't have such difficulty in collecting your bills. Sometimes your customers run away, sometimes the bill gets too large, and I think monthly reading is the better way.

Mr. Fisk: In regard to the number business, we find the serial numbers change with some manufacturers. For instance, they will come out with a meter No. 650 Type F; after a while another meter, 650 Type J, or something else. To get over that difficulty we started with our own local number, started with No. 1, and worked up, and we found it simplified things very much.

Mr. A. A. Wright: I suppose this matter of station meters could not be worked where you run both on meter and on flat rate.

Mr. Dion: Mr. President, I might say that I would take the station meter to be of special value in a case of that kind. I would compare the output of the station as recorded on that meter with the aggregate consumption as recorded in the consumer's meter; the difference would represent waste; and you could determine on that whether you were getting enough for your flat rates or not.

Mr. Wyse: I would like to ask Mr. Dion if he has adopted the method of having blanks, and having the man that would otherwise read the meter simply mark the location of the hands on those blanks, showing the location of the hands on the dial?

Mr. Dion: Yes. The man has a book and each space contains about four cards; each card is a facsimile of the meter dial, and he takes his pencil and writes the man's name and puts three or four strokes indicating the position of the different pointers.

Mr. Wyse: We make the bill out in the office and give the man those slips in duplicate, one of which he leaves with the customer showing the indication of the hands, and the other one he turns into the office, also showing the indication of the hands on the dial.

A. A. Wright: How do you keep account of these in your office so that at any time you can refer to them?

Mr. Dion: The book is made of such a size that it will last about one reading. We employ two men reading the meters and there are four books; each man takes a book, say, to-day, and he leaves it in the office the day following, so that the records may be transcribed from the books, and when they are through with that reading the books are about filled, and they are filed away, and a new set of books taken out next time.

A. A. Wright: I have never seen anything to equal the system I use myself. We find no difficulty whatever in having the whole month, every man's reading, right in the book, and you can see everything about his meter reading any time you want to let him see what every month's consumption amounts to and all about it.

Mr. Dion: How much room in a book would one customer take?

A. A. Wright: Two pages to one customer.

Mr. Dion: We have over 3,000 meters; that would be 6,000 pages.

A. A. Wright: One man couldn't do all that work; you would have to have several books, one for each reader.

Mr. Dion: Each reader has to have a complete list unless you divide your city into districts.

A. A. Wright: Certainly.

The President: With the Royal Electric Company, we supply our meter readers with a card for each individual customer, instead of a book; that card is arranged to take the readings of one entire year; it recites the name of the customer, the number of his meter, and so on, and gives each reading so that the meter reader has before him the previous readings for all the time of the year that readings have been taken.

Mr. Dion: That is like our system, except that ours is in book form.

The President: The district is divided by the number of cards given to each meter reader; the card shows the whole history of each customer's consumption for a year. The card is numbered with the ledger folio and every man's account in the ledger folio must have an invoice rendered for it, and the card is returnable.

A. A. Wright: You have not one of your cards that we can see.

The President: There will be some presented to-morrow.

Mr. Bilger: Is a new card issued every time a meter is changed?

The President: It is noted on the card.

Mr. Wyse: Do you render your bills quarterly or how?

Mr. Dion: We have two periods of three months each, and three periods of two months each, five periods for the year.

Mr. Wyse: You don't find that there is more objection to paying them on account of the larger accounts than if they were rendered in closer periods, of say a month.

Mr. Dion: We have not tried them monthly.

Mr. Wyse: I presume the other is satisfactory.

Mr. Dion: The other works well.

A. A. Wright: You never lose anything by customers going away.

Mr. Dion: We occasionally lose a few dollars by people not paying their bills, but we have to take our chances in watching those people.

The President: I may say for your information, that in Montreal we had a large number of quarterly customers, in fact, at one time they were all quarterly customers, and new contracts were taken making them pay monthly, and after that had gone on some time we adopted the policy of rendering bills monthly. Those customers whose contracts provided that they should pay quarterly exercised that right if they wished to, but they got their bills every month just the same, with the result that practically every customer that we have now has got into the habit of paying his bills monthly. It was not forced upon them, but they were given copies of their accounts and they found it convenient to pay. It involves of course some work, extra meter reading and extra making of accounts, but we have found in practice we can get in our returns monthly quite agreeably.

Mr. Wyse: Do you find that you have better results from that than when you rendered them quarterly?

The President: It has eliminated a great deal of complaint about heavy bills; and it also affords the opportunity of showing a customer's varying use; that is, if he got a bill for two months in the winter time he would think he had a very large amount, whereas one month may have been large and the other one comaratively small.

Mr. Fisk: Do you ever discount a customer's bill if paid on or before a certain date.

The President: We do not; our rate in Montreal was fixed by contract some years ago, but we have lately inaugurated a varying system of rates, very largely on the lines indicated by Mr. Dion in his paper. We impose a penalty of interest after the date in the month provided for in the contract, and also exercise the right of disconnection. We put that in vogue two or three years ago. On and after a given date the customers were notified that their accounts were not paid, and were called upon to pay them within a couple of days after. If they did not, they got another notice that they had not paid, and that at the end of two or three days more if the account were not paid their service would be discontinued. At the beginning we had a great many disconnections to make and reconnections were made upon their paying a dollar. It has gone on; we have lost some customers of course by it, but with no permanent serious loss, until now we have a very small percentage of customers whose bills are collected by the man who goes around to make the disconnection. That is, they wait until he comes around to pay their bill, instead of paying it to the office.

Mr. A. A. Wright: Where you distribute these accounts over three months you say the date is placed on the bill. I suppose you mean you give them the bill for January, February or March, and you merely say "this account is for these three months"?

Mr. Dion: I give the actual date of the reading. There might be only two and one-half months between the two readings, or there may be over three months, as the man who reads the meter may not get around on a certain day.

A. A. Wright: What about these meters, do you charge rent for them?

Mr. Dion: We charge a rent for them.

A. A. Wright: You add three months rent in every time.

Mr. Dion: Three or two as the case may be. We get twelve months in every year.

T. R. Rosebrugh: I would like to suggest, in investigating the question of the behaviour of recording watt meters on inductive loads, it might be well to use a small machine having six collector rings, of which three might be three phase and three six. In this way, with six collector rings, you can get the phases all the way around the circle, 15 degrees apart, and by a suitable combination of a non-inductive load, you can divide the 15 degree phases so that you can have the phase angle almost anything you please.

Mr. Dion: I would like to say a word in reply to what Mr. Gossler stated in connection with meter testing. He objects to testing meters in series because he says an inductive load is introduced which makes the meters go faster. We do not care in that particular test how fast or how slow they go, provided they are all affected alike. The master meter or standard is first carefully tested at all the loads, and it is then used as a standard in series with the meters to be tested, so that so long as the meters are all affected alike, the master meter and the others, we don't care anything about the speed, because we compare the consumption with that of the master meter to determine the accuracy of the meters afterwards.

Mr. Wyse: But then we have to lose so much revenue from having the record incorrect.

Mr. Dion: We first test the master meter for accuracy and then we test the other meters by comparison.

Mr. Wyse: Subject to the inductive load.

Mr. Dion: So long as the master meter is affected in the same manner as the others the particular speed does not matter, because we know that the master meter is correct.

Mr. Gossler: In connection with that matter, I notice that Mr. Dion suggests counting the revolutions of the meter, and if you are going to count the revolutions you have to take the individual meters and test them. If you adjust each meter for an inductive load and place that meter to register on a non-inductive load I don't see how you are going to have it register correctly. There is another thing I would like to bring up in connection with this matter, for discussion, and that is the advisability of adjusting the meter for operating correctly on full load. The time that the meter is in operation or in service on full load is a very small proportion of the total time it is in use, and we have found that adjusting meters for three-quarters load is more equitable both to the consumer and for the company. If you adjust meters to operate correctly at 3 4ths of the load and keep within the government restrictions, I think the results will be certainly more equitable to all concerned.

Mr. Dion: If you refer to my paper you will see we test them at half load.

Mr. Gossler: I beg your pardon.

Mr. Dion: We test the master meter at several different loads but we test the others at half loads.

The President: I suggest that this discussion be not closed to-night, but that we close our business for the afternoon, with the understanding that in the morning the further discussion of this paper be taken up, and that you occupy your time all evening getting up what you wish to say on it. There is a great deal yet to be said on this subject, and it is worth a great deal to the operating companies to have it all exhausted and ventilated. We will now adjourn for this afternoon.

At 5 p.m. the members made an excursion over the Hamilton and Dundas electric railway, and at 7.30 p.m. over the Radial Electric Railway to Burlington Beach, visiting en route the power stations of the radial railway and the Hamilton street railway. Unfavorable weather precluded the enjoyment of an excursion by steamer as per programme.

SECOND DAY.

At 9.30 a.m. the President resumed the chair, and in calling the convention to order said: Before proceeding with the regular business, with reference to the Nominating Committee, it has come to my attention that some dissatisfaction exists with some of the members at the action of the Executive Committee in undertaking to appoint a Nominating Committee. I endeavored to make it clear yesterday that the action of the Nominating Committee is in no sense binding; that everybody here has a perfect right to put in the names of candidates when nominations are called for. The Executive Committee did not intend and do not wish to take out of the hands of the convention that which belongs to it, and I want to say right here and now that if there is anyone who objects to the action of the Executive Committee in appointing that Nominating Committee we should hear from them now. We believed that we were representing the sense of the convention in endeavoring to concentrate our action in nominations, but if there is any objection to it I want everyone to make objection now. If it be the sense of this convention that the Nominating Committee shall not put in nominations, we will ask to have the Nominating Committee discharged; but do not let anyone go outside and say, "Well, I don't think the Executive Committee ought to appoint a Nominating Committee." Say it right here and now. If the Executive Committee have done more than they ought to, sit down on them hard and they will get out.

A. A. Wright: I may say that for one I was very well pleased when the matter came up in the way that it did. I have no idea that this Association should be run by a clique or should be in the hands of a ring, but we must have noticed that when nominations are made miscellaneously one man nominates a friend of his and another nominates a man because he chances to know him, and this thing works wrongly. A nominating committee know all the ins and outs of this thing, and are supposed to take the matter into deliberate consideration and see that no man is nominated without having his status and the branch of the industry which he represents thoroughly discussed. Although I am a central station man, I don't want this institution to be run by central station men. I wouldn't like to see telegraph men run this institution, neither the telephone men, but I believe we should live harmoniously together. We are all here to help develop this one branch of the industries of Canada. This committee, when they nominate a man, ought to take these matters into consideration, and I believe that they will. And then, as our President has very truly remarked, we have a safeguard; if there is any man who has been left off, we have a perfect right to nominate that man and give our reasons for nominating him, and if we as a body think he should be elected we have a perfect right to elect him. But I believe this is a good way of doing the work; it has been found to work well on some other occasions. I would like to see every single branch thoroughly and well represented on the board. I don't want to see any branch enjoy a monopoly of control. (Applause.)

The President: I take it from the applause to Mr. Wright's remarks that there are no objections to the course of the Executive Committee in appointing a nominating committee—therefore I will hope to receive a report from them during the day as to the names of the officers of the Executive Committee, of the President, 1st Vice-President and 2nd Vice-President, but before coming to that point we will proceed with the regular order of business, and that matter will come up under the title of general business. The first order of business is consideration of the reports of committees. We received the reports of the committees yesterday and they were accepted and approved, but the consideration of the recommendations made in those reports would appear to be covered by this item of the "order of business"; and perhaps the first and most important recommendation is that one of the Committee on Legislation, that the members of this Association formulate some plan covering a period of say five years, whereby each company will contribute yearly a given sum towards the necessary expenses of the Legislation Committee. As Mr. Yule very properly stated yesterday when the time for legislative work begins, a good deal of the energy of the committee is lost in finding funds. They are hindered in the beginning; they don't know whether they are going to be able to carry out what they wish, because they are not in possession of funds, and funds are undoubtedly necessary to employ representative lawyers and capable people to look after matters, and besides that and beyond that, the idea conveyed by the committee's report was that the Association should be kept informed, kept in touch with all bills presented to the legislature which may affect the general interests of electrical industries. Therefore I think the first question to take up this morning is the formulation of some method whereby that idea can be put into effect, and I shall be pleased to hear from any of you as to what can be done in that direction.

Mr. John Yule: As I understand the report, our recommendation or suggestion is that our successors in office of the new Legislative Committee take that into consideration. At the same time it is brought up for hearing what suggestions may come from members of the Association to give the committee an idea in what lines to work.

The President: As a very active member and an old member of that committee have you any suggestions to offer as to the amount of annual contribution the members might pay? I bring that up merely that it may be considered here, and while perhaps not acted upon, the idea will be growing.

Mr. Yule: That question has passed through my mind several times as to what would be a proper or reasonable amount for the different companies to agree to contribute for five years, and I don't think, even from the large companies, we would want more than $10, and going down as low as one dollar or two dollars per year. It may not be used and it may not be necessary, but during that five years a crisis might arise in which we would want quite a sum of money, and by gathering this fund we would have it in hand. It is thought well we should retain a solicitor in Toronto, examine every bill that is introduced in the legislature of Ontario and in the Dominion house, and see that nothing is lost sight of.

The President: I trust you will not leave out the province of Quebec.

Mr. Yule: We discussed this morning upstairs the question of electing a separate committee for Quebec.

The President: Covering the same idea?

Mr. Yule: Yes. By collecting this fund we would have an amount in hand in case of emergency: We do not want any large amounts; we rather want a large number of small amounts from a large number of companies. If we got 100 companies to enter into an arrangement such as that, if the sums range from one dollar to ten dollars it would be quite a sum in the aggregate, but it would be a very small amount for those contributing. It is entirely voluntary, and you have to use a good deal of judgment in asking them to contribute. Some companies are better off than others, and some are more willing than others, and it will take a good deal of work to get this scheme organized and get it carried out, but I think it can be done. That is what passed through my mind in making that suggestion. We talked it over at the last meeting of the committee and concluded that something of that kind to successfully attend to this business will be necessary. We have attended two meetings of the legislature; I have been pretty constantly in attendance at both those meetings, and have noticed the way in which legislation is introduced and carried through. Something may arise in a town or village or city; the corporation wants something carried through and they find the act interferes with it; they lay the matter over, and they ask their member to introduce an amendment to that act that will comply with their conditions, with what they want to carry through, and that amendment has to apply either to the whole Dominion, if it is in the Dominion house, or to the whole province. It is often looked upon as not amounting to anything, while very often it is a very serious amendment to an act and it goes through without anybody knowing anything about it, or without anybody being on the ground who is posted on that particular subject to point out where it will operate to the detriment of others, where there are a larger number of people interested, although it may be an advantage to that particular village or town or city. The members do not attend to their duties as they ought to. We all ought to get copies of those acts, and that is part of their duty. I suggest to the gentlemen here now, that they should remind their members in going to either of the Houses that if a bill is introduced that affects in any way a lighting company or any other branch of the industry, that they should send copies of that bill to them. I don't know that I can say anything further to impress upon this convention the importance of this matter being attended to, and of organization for the purpose of attending to it. Mr. Wright has had a good deal of experience, perhaps he can say something. (Applause).

The President: I understand your suggestion to be that this would be a contribution by companies and not by individuals?

Mr. Yule: By companies, not by individuals.

The President: Therefore the maximum of the expense, $10 a year, which you suggest, would seem to be not at all severe upon any operating company?

Mr. Yule: That was the idea.

The President: While a company may have in it a number of members of the Association, as a company the amount of $10 would not be too small an amount to be paid by any of them, and, as you say, if we could get 100 companies organized together to contribute a fund amounting to say a thousand dollars a year, it would put the Legislative Committee of this Association in such a position that the interests of all could be guarded. Being forewarned by knowledge of legislation going on or offered, it could be very easily overcome; and I think it is proper for us to realize and scatter broadcast among those who are not members of the Association, the idea that this Association desires legislation that only is just and equitable and fair, and that we are organized together for protection against unfair legislation only; therefore our efforts are entirely proper. We have communitive interests usually, and by making our efforts in the direction of proper legislation and guarding against improper legislation, we have a concrete idea to work for which will make our Association powerful and popular and give a reason why companies who are not represented should find representation here. We should grow—and it seems to me that the kernel of that growth is now planted by this legislation obtained last year. I suggest that it be expressed as the sense of this Convention that the next legislative committee be authorized and empowered, and if you please, directed to endeavour to get every operating company in Canada as members of this Association and contributors to the legislative fund.

Mr. Yule: I would not like it to go out that the Association expects $10 per annum from every company. I would mention $10 as the maximum and $1 as the minimum.

The President: It seems to me one dollar is too insignificant a sum for any company. For an individual it is another thing. There is not an operating company in Canada to-day that does not squander $10 for other purposes without hesitation, and it does seem to me that there is not a company in the whole of Canada that would be impoverished or hurt by the contribution of $10. The larger ones can give more if they want to.

Mr. Yule: The method might be adopted this year in sending out agreements to different companies (you know we got an agreement printed for the company to sign, and along with that agreement the amount was suggested to the company; they considered the circumstances of the company and took the liberty of suggesting to them what they thought would be a proper amount for them to contribute, and that worked very well).

The President: That had reference to a special amount which you wanted to raise, not to a continuing yearly amount?

Mr. Yule: Yes. The same principle would apply.

The President: You wanted $100 from some of them and you were content with $5 from others.

Mr. Yule: Yes.

The President: This, I think, is a different line. Those who have contributed $10 yearly may, on occasion, find it necessary to contribute more.

Mr. Yule: The whole of those yearly subscriptions will not be used up each year.

The President: Not each year, no.

Mr. Yule: The committee went over the list of companies and used their judgment in suggesting to those companies the amount they thought they could contribute or agree to contribute, and I do not see why the same method should not be adopted in applying for the yearly subscription.

The President: My suggestion is not that the Legislative Committee receive as the sense of this convention instruction as to the amount that they should seek for, but to have it expressed as the sense of this convention that the most important work that we have in hand now and may have for some time to come is the procurement of proper legislation, and that the Legislation Committee endeavor to get all the companies in the country interested as contributors to a necessary fund.

Mr. Yule: I would like to explain to the Association and have it go out to the companies that the lighting companies in a great measure are handicapped, owing to the division of interests. Other interests are more concentrated; they may be under one board of management, they can bring their influence and do their work in a moment's notice. We are largely handicapped by the amount of work we have to do to get those who should be interested to take action or to support the action of the committee.

A. A. Wright: I would particularly support the position Mr. Yule has taken with reference to the attitude central station men should take with regard to their representatives in the legislature. I think this is a good idea, if we can only get the central station men to follow it up. Take South Renfrew for instance. We have five companies in South Renfrew, and if every one of these companies annually when the local legislature met were to drop a card or letter to our representative, stating to him that they wanted him to be careful and let them know at once if any legislation of any kind whatever were introduced with reference to electric lighting or touching electrical industries if that representative got five letters, one from each of the different companies, he would begin to think there was something in it. He wouldn't want to have the antagonistic element working against him, which these companies could bring to bear, and he would be on the qui vive to keep close watch of what was going on and let these men know. The great difficulty that I see is to get central station men to do their part. It occurs to me to suggest that if this committee should strike off a copy of a letter and every year when the legislature meets should send this letter to the managers of central stations and say, "Would you have any objection to copying out this letter and sending it to your representative in the local legislature?" Certainly that would bring this matter to their attention and I don't think the central station man would object to doing that much in his own interests. My idea is that this committee which is appointed to take this whole matter into consideration—I am following up what Mr. Yule suggested in order to bring ideas before this committee—ascertain how much it is going to cost to pay a lawyer to watch this thing in the legislatures, and when we get an idea of how much our expenses are going to be annually, and how much of a sinking fund is required, they would form an estimate of how much of an average would be necessary for central station men, or those engaged in electricity, to give; and that would give us an idea of what we ought to do.

J. J. Wright: I would move that that Committee take these matters up and if the resolution is put in the words that you, Mr. President, gave us a short time ago, I think it would cover the ground.

Mr. Wyse: I second the motion. I was going to say, I don't think the Association wants to give the Committee on Legislation detailed instructions. They are appointed for that business, and they should be capable of discharging it. Whether they adopt a means of looking after the legislation that may come up through central station men, or through lawyers or through both, the manner and details of looking after it should be left to them.

Mr. Yule: The duty of a lawyer would only be to look up the acts that affect us, or amendments rather, and see what the effect of those amendments are.

The President: I understand that the motion does not pretend to enter into details, but to express as the sense of this Convention that the care of looking after proper legislation be the especial duty of the legislative committee, and that they give their best attention to it. No instructions in detail whatever.

A. A. Wright: We were only giving suggestions.

H. R. Leyden: Am I to understand that this committee is look after all electrical legislation? It has been spoken of a number of times as simply taking care of legislation affecting central stations. My idea is that they should include the telephone, the telegraph and other electrical interests as well. Although the Bell Telephone Company have an attorney acting for them, still our attorney would work in conjunction with him. There has been considerable dissatisfaction with the method that has been employed heretofore in looking after this legislation, and there has been friction between telephone, telegraph companies and central station men, and I think the scope of this committee should be broadened sufficiently to allow them to take care of all electrical interests.

Mr. Wyse: I think, in that case, the telephone companies and telegraph companies, as well as central station men, should contribute their quota towards the expense of looking after this legislation, and not alone central station men.

The President: Both suggestions, I take it, are fundamentally correct.

Mr. J. J. Wright: I think if our Association would co-operate with them, I have not the slightest doubt that they would be willing to meet a subscription covering expenses.

The President: I have no doubt that the Association would be very glad to afford to telephone, telegraph and street railway companies, information which they might obtain in regard to legislation going on, and perhaps in that way make it manifest that our action is beneficial to them as well as to ourselves.

The President put the motion, which, on a vote having been taken, was declared carried.

The President: Is there any other report or recommendation of committees to be considered? (No response.) That appears to be all the consideration you seem to want to give to reports of committees. The next business on the programme is the election of the standing committees, and we will receive the report of the Nominating Committee on that. The Nominating Committee recommend as the Committee on Statistics: Mr. J. A. Kammerer, Toronto; Mr. A. A. Wright, Renfrew and Mr. J. F. H. Wyse, Brantford, Mr. Kammerer to be chairman of the committee. Does this recommendation meet with your approval? (Carried.)

The President: Committee on Meter Inspection—Mr. A. A. Dion, Ottawa; Mr. E. E. Cary, St. Catharines; Mr. J. J. Wright, Toronto; Mr. Dion to be chairman. Does this meet with your approval? (Carried.)

The President: Committee on Legislation—Mr. J. J. Wright, Toronto; Mr. B. F. Reesor, Lindsay; Mr. C. B. Hunt, London; Mr. John Yule, Guelph; Mr. H. R. Leyden, Hamilton; Mr. A. A. Dion, Ottawa; Mr. W. H. Comstock, M.P., Brockville; Mr. A. L. Briethaupt, Berlin; Mr. Wright to be chairman. Does this committee meet with your approval? (Carried.)

The President: In the report of the committee to confer with the Fire Underwriters there was a suggestion, perhaps not definitely expressed, that it might be well to continue that committee, not with the hope of doing very much with the Underwriters, but perhaps in the hope that municipalities might ordain certain ordinances which would bring about the inspection of wiring by the civic authorities instead of by the fire underwriters. Do you wish to have that committee continued with that object in view or let it die?

Mr. J. J. Wright: That refers principally to the province of Quebec, I understand. I don't know that I should be in a position to criticize. If that was referring to Ontario, I should certainly object strenuously to have any power of that kind put into the hands of the municipality, taking into account the manner in which municipalities handle those matters as a general thing.

Mr. Gossler: I might say for Mr. Wright's information that Mr. Hadrill, Secretary of the Board of Fire Underwriters, which I think covers the Dominion, stated that the Fire Underwriters hoped and expected that the municipalities throughout the Dominion would enact by-laws that would make the enforcement of the Fire Underwriters' rules part of the building laws, and he said that was being done in the United States; there were over sixty municipalities there that had included in the by-laws enforcement of the Fire Underwriters' rules, and there had been two towns in the Dominion of Canada, the city of Winnipeg and the municipality of Brandon, so evidently the fire underwriters were starting out with the idea of making inspection part of the municipal by-laws.

Mr. J. J. Wright: My experience of municipal representatives is that they are competent to handle things of that kind.

Mr. Woolsey: In the States in the last few years they have had this matter up before the councils of the various cities there, in relation to the fire underwriters' rules and regulations, and the majority of the cities have taken those rules and placed them among all their other building rules and regulations. Not only have they gone that far, but they have also appointed a man who has to pass a civil examination electrically as an inspector of electrical work and apparatus installed in those cities. Besides that, the underwriters themselves have an inspector or inspectors, who cover a certain territory, and before any work is done electrically in any way, they have to apply to the various electrical inspectors of the various cities in which the work is done before they go ahead. They must get a permit from him before they do any work. After the permit is given they have to apply to some of the managers of the board of fire underwriters in the various localities and secure a permit from them before they can go any further. After that permit is granted they go ahead and do their work, and then the inspector must inspect it before any current is turned on. They have made it a very rigid rule, and in consequence the work is being done far better than it has ever been done before. There has been less trouble in the last five years in electrical wiring than in all the years before, and it is all through the municipalities adopting rules and regulations laid down by the board of fire underwriters.

Mr. Wyse: I think the municipalities adopting those rules and trying to enforce them would only be an assistance to what we want at the present time, perfect wiring.

The President: In the Province of Ontario it happens that one of our very oldest members has the matter of inspection in charge, and it is undoubtedly through his personality that common sense application of these rules is given, but elsewhere the whole difficulty with the situation is that there is no centralized anthority anywhere which can call upon and be called upon to see that any given set of rules is carried out, and the sense of the convention last year was that the advantage of the operating companies was to have some authorized authority who would look after this matter and see that any rules, be they whatever they may, be carried out. Now, whether it be by the municipalities or board of fire underwriters, is immaterial. If the municipalities take the rules of the board of fire underwriters, and make them the law of their municipality, then it becomes incumbent upon everyone having to do with them to execute the law. Thereby we get a responsible centrallized authority, and, as Mr. Woolsey said, any corruption or mismanagement is guarded against in the States by the board of fire underwriters in addition giving a certificate. Therefore, if there be any contradiction between the action of a municipal inspector and the underwriters' inspector, it is discoverable at once. If the corruption extends to the inspector of the board of fire underwriters as well as to the inspector of the municipality, then of course the company or customer suffers. But when you establish a certain principle by law, then you have a lot of inspectors, that is, you have the general public and the law itself. Last year it seemed to be our view that we wanted somewhere in some place somebody authorized to supervise this thing intelligently.

J. J. Wright: I think the whole loss falls on the fire underwriters; they are the proper parties to see that the work is done according to their ideas.

Mr. Gossler: In regard to that, the committee tried to explain to the sub-committee of the fire underwriters that the fire insurance companies were really the losers in the matter, but they did not seem to see it in that light. It seems to me they are perfectly willing to accept the certificates of the electric lighting companies if they will certify to the fact that the wiring has been done in accordance with the board of fire underwriters' rules; but for the lighting companies' and power companies' own protection I think there should be an independent inspection from an outside source. I speak of that for this reason when it is left to the electric lighting companies or electric power companies they are liable to draw on their imagination as to what constitutes compliance with the board of fire underwriters' rules. I know of several cases where very objectionable installations have been put in and objected to by one company, and another company has come along and taken them right on those lines.

The President: Is it your wish, gentlemen, that this committee should be continued, to report at the next convention what they find can be accomplished? (Motion carried to continue committee.)

A. B. Smith: Who are the committee?

The President: Mr. Dion, Mr. Gossler and Alderman Sadler. There was another member, Mr. Badger, and it would be proper to appoint someone in his stead, and I will be glad to receive suggestions. Mr. Badger was appointed because he was in Quebec. Mr. Sangster, would you be kind enough to act as the other member of the committee? Mr. Andrew Sangster will be the remaining member of that committee. Now, the next business before us is the selection of the place and time for the next meeting of the convention.

Mr. Dion: I desire on behalf of Ottawa city to extend a cordial invitation to this Association to hold its next convention there. I can assure you of a very hearty reception, and I do not think it is necessary for me to say very much in support of this invitation, because it would seem as if it were Ottawa's turn to get it. We have not had a convention of this Association for five years; since that time it has been in Toronto and been further west and also further east. Ottawa is a central place, and I have spoken to a number of members about it and they seem to be quite agreeable to the idea. At any rate, I propose Ottawa, and I hope the convention will decide to come there. (Applasue.)

The President: It does not seem to be any use to ask for any who are contrary minded to speak—therefore it will be Ottawa next. (Prolonged applause.) The next item on the programme is General Business.

Moved and seconded, that this Association express to Mr. James Conmee its appreciation of his earnest efforts in securing equitable legislation concerning the electrical industries of the province of Ontario, and that the combined Executive and Legislative Committees be instructed to convey this expression to Mr. Conmee in a proper and fitting manner.

A. B. Smith: I would move, seconded by Mr. Yule, that our Secretary be allowed the usual grant for the year. Carried.

The President: Now, gentlemen, we arrive at the question of papers, and we adjourned yesterday with the discussion upon Mr. Dion's paper unfinished. We had, perhaps, fully exhausted that element of the subject having reference to testing and methods of reading and so forth, but have not taken up the question of rates. If there be anything more to be said on the matter of meters, meter placing, meter testing and meter reading, we should be pleased to hear from you now, and I want to repeat what I said yesterday, that I hope that everyone here will take an active part; if necessary, rap another fellow over the knuckles in order to get some fire into our discussion.

Mr. C. H. Wright: Mr. Dion in his paper at page 2, section 4, says, "The current should be calculated from the indications of a Siemens dynamometer. If none is available, the wall ampere meter, which should be frequently calibrated, may be used instead." I think a Weston ammeter will be found more convenient and reliable. Last year Mr. C. E. Haskins, the meter expert, provided a plan of testing meters in houses. He takes a bank of lamps of a lower voltage than those in use on the company's wire and calibrates them at different voltages, and he can test the meter without any disturbance whatever, and this removes any doubt that may be in the consumer's mind as to the accuracy of the meter. On page 3, under the heading "Station Meters," Mr. Dion says, "The practice of metering the output of the central station, which is becoming quite popular, is a move in the right direction. The data obtained through the use of station meters is not otherwise available. It is sure to lead to economies in the station, and will be of material assistance in making and re-adjusting rates." I doubt the reliability of this data. Furthur back Mr. Dion refers to the size of meters in relation to the load. When we install a large meter for measuring the total output, this meter at certain hours of the day will work on a very light load. Take the case of hotels, where the lights are burning late, you will have lots of meters working on practically full load, whereas your large meter in the station is working on low load; in fact, after twelve o'clock it is no uncommon thing to see this large meter stop altogether. You take and add up your house meter readings and check them against the main meter in the station, and the difference is altogether too great. Large differences in stations, perhaps, are to be looked for where we have transformers. In one station where I was employed, we thought there was something the matter with the meter, and had it recalibrated; in all cases we got difference of from 20 to 30 per cent. between the total readings of the house meters and the main meter in the station. I know we calculated our other losses to be about 5%, and the transformer loss could not have made up the 25 per cent. difference present. So that the fact of these large meters working on small load, looks to me as though the data thus obtained is not perfectly reliable.

A. A. Wright: We had as high as 36 per cent. loss once in a large bank of transformers. You promised to show us that card.

The President: That will come up in the reading of the next paper. Is there anything further desired to be said on this question?

Mr. Leyden: I want to say a word as to what Mr. Dion said as to when a customer objected to the reading of the meter, immediately removing it and replacing it by another meter. To my mind this is not the best way out of the difficulty. Mr. Dion states that it is not the proper method to test a meter on the premises. While you might not be able to get as accurate results on the premises as you would in your own testing room, still, if you do get any results at all, and they are anywhere nearly correct, the customer is a great deal better satisfied, and is very much less liable to complain the second time than if you take the meter out and put in a correct one. If you can show to him right on the premises that the first meter is correct, you are not liable to have much further trouble.

Mr. Fisk: I do not think it is hardly the right thing to do to have to humor every customer into believing his meter is right. We pay the Government for informing the public as well as ourselves that these meters are correct, and if a record is kept of the original test of these meters, and that is shown to the customer, I think that is far enough. If he is dissatisfied, then the law provides that by him depositing the proper amount the meter can be verified, and then there is no doubt about it at all. If you try and humor every customer that is dissatisfied, you have abig job on hand. If you take one man's meter out and put another one in exactly the same, perhaps his conditions will change a little; he gets better results and he at once says, 'I know what is the matter, that other meter is wrong'. He tells all his friends, and you have got to change everybody's meter; whereas probably the meter is all right. We pay the Government for testing these meters, and they have the option of depositing their fee and getting the certificate themselves, and if they do that, this certificate not only answers their purpose, but it also gives the lighting company another lease of life for five years on that particular meter, wnich I think is the proper way.

Mr. Dion: Have you any competition in your town, Mr. Fisk?

Mr. Woolsey: This meter question I think would apply to the province of the legislative committee. In several cities in the States that same question of doubt has arisen with the subscriber or with the consumer as to the meter being correct or not. It has gone into the board of electrical control of the various cities. When the consumer makes complaint or has an idea that his meter is not reading right, he applies to the board of electrical control, the inspector of it is the inspector of all electrical work, and the customer has to take his meter out and take it to the inspector's office, or else the inspector comes to the house and inspects the meter, and then if the meter is found to be out, or is found not to be correct, the company has to pay one dollar to the inspector and put in a meter that is right, but if it is found to be correct then the customer has to pay the dollar to the inspector.

Mr. Yule: Our practice has been to explain to the customers complaining of the meters that our measures are certified to by the government as being correct; that we have practically no control over the meter; that it is tested and sealed up and put on the premises; and we refer them to the inspector without giving them any information as to making a deposit or anything at all. In nine cases out of ten we do not hear anything more from them The inspector explains to them what the operation of the law is and what is necessary.

Mr. Henderson: In reference to testing meters in houses, you take a meter that has been changed from store to store and the meter has been running slow; it is moved to this new place and through transit it has jarred the jewel and it is running slow, whereas in the last installation the meter was probably running fast. Another point in changing meters: A man complains of his bill; it is true that the meter, from his previous readings or accounts, is running fast; at the same time, if that meter were tested in that house without removal, it would obviate the danger of jarring the jewel and it would be a great advantage.

A. A. Wright: It is very fortunate that Mr. Dion introduced that clause into his paper. You can not give any hard and fast way in which these things can be adjusted. A great deal depends on the man that has to deal with the woman. (Applause). You have to be guided by circumstances. I am not particularly touched with the blarney stone of the Irishman, but still I find it necessary to use the persuasive element with a great deal of dexterity and a great deal of suavity of manner to get over these difficulties; you can't handle any two alike. When all fails I tell them that of course it is possible this meter may be running wrong, but we believe it is right, and if they are prepared to put up sufficient money to pay the expense, we will bring the government inspector and have it examined, and if it is wrong we will pay all expenses, but if the meter is correct and found to be going right they have to pay the expense. I never found that to fail in satisfying the woman.

Mr. Yule: The only way is, if they think it is desirable to have an inspection made of the meters on the premises, let the Government inspector do it; he is the most neutral. If officials of the company go there for the puspose of persuading the people that the meters are all right, it will have little effect.

Mr. Dion: I find in Ottawa that the Government inspector refuses to test meters on the premises; you have to take the meter down and take it up to his office, so that unless the owner of the meter comes along with his meter, there is no certainty to him that the meter has not been tampered with before it reaches the inspector. I would like to know what the practice is in other places?

A. A. Wright: One other scheme I have adopted with reference to this—when the first complaint is made I say, "really, I don't think there is anything wrong with this meter, for this reason, that the meter we have put into your place is a test meter that we got from the factory expressly to test our meters by. (Laughter.) It is not any ordinary meter that you have in your place, but it is a test meter."

J. J. Wright: May I ask Mr. Wright what particular church he stays away from when he does not go?

A. A. Wright: Mr. President, I am a leading member of all the churches. (Applause.)

Mr. Gossler: Three or four years ago the Royal Electric Co. had numerous complaints from customers of their meters either humming or running too fast, or not in accordance with the light consumption, and we undertook to maintain that our meters were right, although we didn't know quite ourselves whether they were or not. But we undertook to say they were right. We started an investigation, with the idea of being able to maintain that those meters were right or else finding out for ourselves whether they were right or wrong; we started out with a very thorough investigation and made tests. I may say safely that we had hundreds of complaints of meters running fast. Since that time we have gone into it not with the idea of humoring the customer, or using blarney, but maintaining that what we said was correct. We reduced our complaints down. We have some 3000 meters in use, about 3000 customers, and I am safe in saying we have not within the last year had 25 complaints; we have, in every case, undertaken to show the customer that the meter was correct; we then tell them that the meter has been subjected to our own test, and has been passed by the Government inspector, and if they so desire they can call in the Government inspector to verify our statement; and we have practically eliminated complaints from customers. We use several meters the Schallenberger meter principally, the Siemens meter, and some Duncan meters. I don't think it is a question of humoring the customer at all, it is maintaining the fact that you are right.

J. J. Wright: The unfortunate part of this business is that meters very often do go wrong.

Mr. Gossler: I may say in connection with that question that we have taken up the matter so thoroughly that we do not find that many of our meters go wrong.

J. J. Wright: That would refer more particularly to alternating current meters, which you know are very much more reliable than the meter used on direct current.

Mr. Street: I find about the easiest way to satisfy a customer making any complaint is to maintain that the meter is correct, and to at once refer to the account and say, have you compared your account for a period this year with the corresponding period last year; and on doing that (it can be done in a very few minutes in the office), I find the customers are very easily satisfied; that in many cases it can be shown that the accounts are not any higher, very often less, and they go away quite satisfied. I find that a very satisfactory way.

A. A. Wright: That is a good way; that is one of the ways I have adopted too, when everything fails.

The President: Apparently you all realize the same thing. After all, the most effective way of dealing with your customer is to take him entirely into your confidence; explain to him fully all the workings of the meter, explain to him why his meter operates, why it registers, and why it registers a certain quantity; inform him as much as you can, give him all the information you have on the subject yourself, and he then realizes that you are intending to give him what he pays for, and that you desire him to know how he can determine it for himself; and I may say that I have found that method effective rather than when any referment to the government inspection or any test or examination was offered. The very fact that you tell him all that you know about it, so that he will understand that you take him into your confidence, satisfies him. If there be no other remarks on that branch of the subject we will take up the question of meter rates. For the purpose of starting the discussion, I may say that in Montreal we have practically three systems, one of them is the single rate, another is payment of a given amount for the first hour per lamp per day, and a very small amount for anything in excess of the first hour per lamp per day; the third method is to charge a fixed monthly sum, that being ascertained and determined by the leakage current of the transformer having been ascertained and a value put upon that; then the value of the transformer ascertained and a percentage of that amount added to the leakage current value, and in addition to that a sum representing the interest or return that you want upon the capital invested in your entire plant for that amount of current that that man wants as represented by his transformer capacity. We have figured those out for all the various sizes of transformers so that our canvasser is able to say to a man, if you want a 50 light capacity transformer you will pay us so much per month and without any reference to your burning, and in addition to that pay us a sum for the current register. That plan is perhaps the most fair to all parties, but it is not accepted by some of the customers because it calls upon them to pay more than they would pay upon the single rate plan, thereby determining that they as customers upon the single rate plan are a loss to us, because the fixed sum that we determine in that way covers the cost of current that we give him in leakage, covers the cost of the investment we have made to be able to give him the service up to that capacity, then the amount that he pays for the current that he uses represents the costs of making and delivering that current to him, plus whatever profit we want on the transaction. Thereby every customer is placed upon an even footing, each man pays his proportion of the investment that is made for him, and he actually pays the cost of manufacturing the current which he actually uses. I may say that we have on the first hour per lamp per day plan, and upon the transformer leakage or energizing plan, customers to the extent of nearly 2000, our single rate customers being principally residences and some small stores. Either of those plans cultivates the long hour user, or the use of the current for a longer period. When you make the price for the excess over the first hour per lamp per day small, the user does not feel the necessity of econimizing and cutting off the light; that is, he feels he can burn another hour with very small cost, and that encourages, therefore, long burning. On the other plan the man realizes he is paying for the current he actually consumes and a small amount to excess to make the total price less per hour when he uses more current.

Mr. Fisk: When you have a number of customers and varying loads on one transformer, how do you arrive at it then?

The President: We undertake to determine the maximum transformer capacity of each customer and rate him accordingly for the transformer energizing term.

Mr. Bilger: Do you give the customers a chance of changing to either one or the other of these methods?

The President: Not after he has made his contract; we have that determined at the beginning; and I may say we try to point out to the customer what the effect of the different plans would be.

Mr. Wyse: Do you endeavor to put all your customers on contract?

The President: We have none that are not; we won't take a man that is not.

A. A. Wright: How long is your contract made for?

The President: We have nearly 2000 for five years and none less than one year. We will not take a contract for less than one year, except that which is known as temporary service, and for temporary service the customer pays the cost of installing and the cost of removal, and then ordinary current rates if the service is in the summer; if it be at the time of our heavy load in the winter, we make him a special price. We take no one without a signed contract.

A. A. Wright: What do you mean by removal?

The President: The cost of removal of the installation. Suppose a man wants to put up 100 or 200 lights for illuminating, he has to pay the cost of putting up and taking down

A. A. Wright: That is when it belongs to you.

The President: Yes. We don't wish to give a customer the right to withdraw at any time he pleases; we must formulate and arrange our business so that we know what we have in sight, what we can prepare for; the question of competition does not enter into it at all; when we make arrangements to supply a man we want to make arrangements to supply him for a given period of time, and that period of time we know, and it is fixed by contract.

Mr. Wyse: Doesn't competition enter into it very materially then, though indirectly, because if you didn't have any contract he would have the right to go to a competing company at any time.

The President: A more important feature would be that he would have the right to give up using the service and go to candles if he wanted to.

Mr. Wyse: If there wasn't some competing company that could give an equally good service, say for instance in electric light, there woudn't be any inducement for him to change.

The President: Perhaps I might better say that it is competition, because it is competition from candles. A man who is not under contract with you and is dissatisfied either with fancied error in his bills or the personality of the manager, may in revenge give up the use of the light, and if he cannot get gas, burn kerosene oil and candles; in fact, we had one case in Montreal where a man wouldn't pay the price we asked him for some temporary purpose who said he would go back to candles rather than burn electric light; and he did, as a matter of fact. The purpose is to hold your business in hand for a certain specified time.

Mr. Wyse: And against any or all competition.

The President: It has that effect.

Mr. Bilger: How would that act with a customer who was put out of his premises.

The President: We endeavor in taking a customer to ascertain his financial status, and if he would be such a one as would be likely to be put out for non-payment of rent, we request him to provide a deposit sufficient to cover about two months' use of his service.

Mr. Dion: In the case of a man discontinuing the light through no fault of his own, having to leave town or something of that sort, do you enforce the contract strictly.

The President: No, we do not. Where a man honestly is unable to carry out the contract, we exercise the discretion of waiving our rights, but the object of the contract and the contract throughout all its phraseology is intended to protect the company against wrongdoers, and not against the man who wants to act honestly. I may say that we have customers who oject to signing our formal contract on the ground that it is too restrictive in favor of the company, but by calling their attention to the fact that it is only restrictive as against those who want to be dishonest, every reasonable man accepts it.

Mr. Noxon: Is your five year basis upon the same basis as the one year, or does it anticipate the probability of reduction in rates before the end of that period? Is there any anticipation or provision for that?

The President: The five year contracts are fixed for five years at that rate; the five year contracts are, as I say, on either of th se two basis that I spoke of, so much for the first hour per lamp per day and a very small amount in excess of that, or transformer energizing current and a small revenue. The single rate contracts are all subject to change in price.

Mr. Noxon: In consideration of a man giving a fixed contract for five years, would you make any reduction in the price for the five year term over and above the price for the one year term?

The President: Yes, these rates I speak of are a reduction.

A. A. Wright: What do you mean by the first hour?

The President: The first hour per lamp per day means the first ampere hour of use, or the first 50 watts hour of use, and it is arrived at in this way: An installation of say 25 lamps should register the equivalent of 25 ampere hours per day. At the reading at the end of the month we will say that the reading of the meter shows that the number of hours is 1200; one hour per lamp per day times 25, or 30 times 25 would be 750 ampere hours to be charged for at the rate of the first hour, and the difference between 750 and 1200 at the lower rate.

A. A. Wright: That causes some labor.

The President: Not very much labor. It is one calculation for the year or one calculation for five years. You have 25 lamps and 750 hours, and that is simply noted on a man's account, or rather 750 hours is charged for at the first price and anything in excess of that is charged at the other rate

Mr. Fisk: How do you keep informed as to the actual number of lamps a man has?

The President: We endeavor to do that in several ways. Where customers have lamps added, as they frequently do, we endeavor to establish the rule, and for their own protection to guard them against being out of a service, to notify us of that addition, and we have made a great many of our customers think that it is to their advantage as well as to ours that they should give us that information; but it frequently happens that they forget it or they do not do it, therefore we periodically make a recount of the lamps in the customers' premises, and our lamp renewing man and our meter readers are cautioned to look out for anything in the way of new work since their last visit.

Mr. Wyse: May I ask how often your meters are read and the bills rendered?

The President: Every month.

Mr. Dion: Mr. President, we have had a good deal of information about your company which is very useful; I would like very much to hear from Mr. Wright, of Toronto, representing a large city, as to meter rates there.

J. J. Wright: If you have any questions to ask I shall be glad to answer them. We have simplified the matter in Toronto very greatly, and at the same time we have the advantage in that way of the demand system, by separating the commercial lighting from the residential lighting, and making two discounts, very largely in favor of the residences. We allow 40 per cent. for commercial premises and 60 per cent. for residential premises, for this reason, that the man at the residence is the long hour burner; he burns his lights every night in the year and for three or four hours per night, probably, whereas the man in the store closes at five or six o'clock and burns his lights only for about a month or two in the winter time, and that only for an hour probably, therefore we make the discount so much greater for residences.

The President: Except when he is off on his vacation.

J. J. Wright: The meter goes just the same. (Laughter.)

A. A. Wright: That would not apply to a barber or men of that kind that burn their lights till 12 o'clock at night.

J. J Wright: We have to make exceptions; we sell our light in Toronto very much in the same way that the huckster sells his fish or the farmer his potatoes, we get all we can for it; and we regulate our rates by the amount consumed, by the number of hours that the consumer burns his light, and we make an estimate very often in each case as to what the rate shall be. This applies more particularly to flat rate customers, of which we have a large number. It is quite as much in order for us to go to a man's premises to make an estimate from the information he gives us and from the knowledge we have of his business and his probable requirements, of the amount of light he is going to use, as it is for a carpenter when he gets a specification for a building; he comes and reads over that specification and looks at the general plan of the building, and what extras there may be, and he estimates what that is going to cost him, and what profit he is likely to get out of it. We go and make a general estimate from our knowledge of the business and from the knowledge of their requirements as to what we can afford to do. I find the plan to work very well. We have very severe competition from the gas people; gas in Toronto is 90 cents per thousand, and that makes it interesting for the electric light people. But I started out with the assumption that we have got to have this business, and if we can't get it at one price we have got to have it at another. I find that works pretty well. As customers become undesirable we drop them off. We have a check meter on all the flat rate customers, and if we find they are abusing our generous confidence we tell them so, and give them a hint that if they want to get a renewal of the contract they will have to moderate their transports or they will not get it again, and that generally brings them to time. So in that way I don't think we lose as much by the flat rate as is commonly supposed.

Mr. Henderson: The two rate system in Hamilton has met with great success. Where we have lost a customer through the gas company, and have had his records of a year's consumption, we have approached the man and made a flat rate with him in this way, by taking the readings for the previous year, and where he was only getting a discount of 25 per cent. we would make it 33⅓, and at the same time making it an inducement to him to reduce and keep his lightingrate down, whereas before with the flat rate he used it extravagantly. We have got quite a number of our customers back in that way. This summer we purpose going in for window lighting, placing them at a fixed rate; and the contract will be that he is to burn the lights until half-past ten or eleven, as the case may be, and then we will have to switch the whole system off. In that way it will illuminate the town and make our light more popular, and be a splendid advertisement for the business men. On the first of May this year we increased our discount on residential lighting, and so far we have received quite a number of customers through it, and in that way, in the course of a few months our residential lighting will increase very largely through the additional discount. We make our residential discount 40 per cent.; it has been 25 per cent. heretofore.

The President: It is now a quarter to twelve and we have several more papers tobe read, and and we are to be back here at half past two; I thought, however, it might be proper to take the necessary time to read another paper, and as the one I have in mind is almost in the same line as the matter we have been discussing, that is, having reference to rates and so forth, and is non-technical, whereas the others are somewhat technical, we might have this paper read just before we close this session now, and after dinner we will be able to discuss it. Before Mr. Hart reads his paper I would call upon some of the members of the Association to express the very earnest thanks of this Convention to Mr. Dion for his paper.

Mr. J. J. Wright: I have great pleasure in moving that the thanks of the Association be tendered to Mr. Dion for the very able and interesting paper he has read on this question.

Mr. Gossler: I, in seconding that motion, would like to call the attention of the Association to the great detail that Mr. Dion has brought out in his paper, and the great value that it certainly must be to anyone who looks over it carefully, I take great pleasure in seconding the motion.

The President put the motion, which, on a vote being taken, was carried amid applause.

Mr. P. H. Hart at this point read his paper entitled "Central Station Accounting from a Business Standpoint." (See page 163.)

The reading of this paper was greeted with applause.

Mr. Hart: The various forms that I refer to in my paper are here for your inspection, and by an examination and inspection of them I think you will grasp the meaning of the paper much more readily.

The President: It is now nearly ten minutes after twelve, and the next session will begin promptly at half past two. Are you desirous of spending a little more time before we close this session?

Mr. A. A. Wright: Will these forms be published?

The President: They will be published.

Mr. Leyden: I don't see that we can discuss this paper very much without havingthe forms before us, because the forms are the substance of the paper; Mr. Hart has outlined his general ideas, but the details are not given in his paper and we can't discuss it until we see these forms.

The President: Suppose we spend a few moments in circulating them around.

On the suggestion of the President the forms were inspected by the members present, after which the President declared the Convention adjourned until 2:30 p.m.

AFTERNOON SESSION.

The President in the chair called the Convention to order and said: Gentlemen, before we take up the discussion on Mr. Hart's paper, I think it is desirable to announce now the names of the officers proposed by the nominating committee. The election of officers will take place to-morrow morning, it will be the first order of business so that you will have before you between now and then, the names of the officers the nominating committee have thought advisable to present for your votes:

"For President, Mr. A. A. Dion, Ottawa; for 1st Vice President, Mr. Geo. Black, Hamilton; for second Vice President, Mr. P. G. Gossler, Montreal. Of the old board of the Executive Committee the five to be re-elected are Mr. J. J. Wright, Toronto; Mr. A. B. Smith, Toronto; Mr. O. Higman, Ottawa; Mr. E. E. Cary, St. Catharines and Mr. John Carroll, Montreal; the new members of the Executive Committee to be, Mr. D. R. Street, Ottawa, Mr. W. H. Browne, Montreal, Mr. A. Sangster, Sherbrooke, Mr. J. F. H. Wyse, Brantford, and Mr. B. F. Reesor, Lindsay."

The President: This is purely and simply in the way of an announcement. Now for the question of Mr. Hart's paper.

Mr. Dion: Mr. President, Mr. Hart gives an account in his paper of how orders for work of various kinds are issued and I would like to ask him if he experiences any difficulty on account of these orders being mislaid by the men who handle them, or whether he has any system of keeping duplicates of orders.

Mr. Hart: I might say for Mr. Dion's information, that when an order is issued a duplicate of it is filed away. The orders are all in book form; the original is taken out; a perforated form is taken out and handed to the man, and the book is filed away serially; a record of unfinished orders is also kept and checked up so that any unfinished order can be checked and called in, and the reason why it is not completed seen.

Mr. Street: The statements in Mr. Hart's paper might almost be taken as a suggestion from him that there should be a committee appointed to standardize the system of accounting throughout Canada; I think this certainly would be excellent, although it might take three years to do it. There is one committee now, it might come under the head of one of the present committees, the committee on statistics; possibly they might consider this. It seems to me this is something that is wanted very much. It would give the smaller companies, in fact, every company, a chance of comparing the particular branches of expense and the particular branches of revenue. At present now, for instance, one company cannot tell very well, supposing he has several hundred lights installed, whether he is getting sufficient revenue from those lights as compared with some other company, and there must be a reason for the difference; the expenditure may be two or three times as great in one company sa in another. If there was some systematic way of distributing the revenue expenditure among all the companies this comparison could be arrived at. I don't know whether a motion to that effect is in order?

The President: A motion to appoint a committee for the establishing of a standard system is certainly in order.

Mr. Street: I would have great pleasure in moving that a committee be appointed to standardize the system of accounts.

Mr. Bilger: I second that.

The President: The motion is that a committee be appointed to arrange if possible a standard system of accounting for central electric lighting stations belonging to this Association. The question is open now for discussion, and in process of the discussion of that motion you can probably further take up the points of Mr. Hart's paper. Does anyone wish to raise any objection to the appointment of such a committee?

Mr. Hart: Speaking to that motion of Mr. Street's, the wording of the motion hardly, I think, covers the idea I wish to convey in the paper, which is, to appoint a committee to standardize the system of accounting for central stations operating in Canada. That is the idea of the paper. Mr. Street's motion is as to the stations the managers of which are members of this Association. I think if the motion were put to read, "the accounting is to apply to central stations operating in Canada," it would more properly cover the point, than simply putting his motion in that form, that the standard system be applicable only to members of this Association.

Mr. Street: I am quite willing to change the motion, in fact the motion may be worded in any way that is suitable. I am quite agreeable to change it as Mr. Hart suggests.

A. A. Wright: If I remember, about four years ago the National Electric Light Association arranged for a thing of this very kind; blanks were furnished and every member of the National Association received a copy of these blanks, but nobody else. Of course, it is not necessary we should follow their rules, but they considered that subscribers or those who assisted in this way should get the full benefit, and those who remained at home in the manger should stay there.

Mr. Gossler: If I understand the paper rightly, the main object of it was to impress upon all the necessity of keeping a system of accounts whereby the cost of production would be obtained, and I really believe there are very few of us who can tell exactly what the cost of production per arc lamp hour is. While I would not for a moment discourage any movement to establish a systematic or standard method of accounting, it seems to me that the first thing to be impressed upon us is to be able to tell exactly how much it costs us. I think the object of the paper is to establish the fact that a system of accounting to obtain those ends is the first thing to be gained.

The President: As I understand the paper, it is a recommendation that some general system that can be used by stations of all sizes, and be of a uniform plan, should be recommended for adoption by the members of the Association, and that the author of the paper has undertaken to show by a system already in vogue, how the costs can be ascertained, and how they can be ascertained in the various forms—the various details of those costs. And the purpose of the motion now offered by Mr. Street, I understand, is to carry out the suggestion of the author of the paper, that a uniform plan be adopted by this committee, and report to the Association as being one that is feasible for all companies to use, and recommend that all companies do use it, so that they will have some basis upon which to compare their various costs of operation, and the various sorts of revenue. Having different methods of accounting, one man is able to say, well, the inspection of my lamps costs me so much: another man is not able to say whether it does or not, because he has it involved with something else. One man is able to say how much it costs him per hour of output for fuel; another man is not able to say that because he has incorporated with the cost of fuel wages of the men, handling, and so on, and I take it that the purpose of the author of the paper and the mover of the motion is, that this committee will take this matter in hand, and endeavor to recommend some uniform plan which will achieve the result. Am I correct?

Mr. Hart: Quite correct, as far as my paper is concerned.

Mr. Street: Yes.

The President: I would like to hear any objection that there may be to this, if any.

Mr. Noxon: I can not see how there can be any objection to it on the part of any person, excepting the committee. This is a thing that is offered to the Association, as I understand, without money and without price. They can use it as they see fit; we don't have to do any work in connection with it outside of the committee. I don't see why we should kick if the committee will do this work; I don't see that we can raise the least objection; I think, on the other hand, that it is a thing that would be of very great benefit. There is no doubt, whatever, that every person connected with electric lighting interests knows that the matter of keeping accounts, and to tell what your light is costing, and what you are producing it at, and what you are getting for it, is one of the most important things in connection with the business, especially in this business where the margins are fine. If this committee will take upon themselves to do this work I certainly think this Association, instead of taking up the matter and debating every question, should be very glad to accept of their kind offer to do so.

The President: I take it, however, gentlemen, that the assentive action of this Association to the formation of such a committee carries with it some application by making use of the results of that committee's work.

The President put the motion, which, on a vote being taken, was declared carried.

The President: I will now appoint as that committee, the mover of the motion, Mr. Street, the author of the paper, Mr. Hart, and I think our friend Mr. A. A. Wright, of Renfrew. (Applause.) Is it desired to have any more talk on this paper? If not we will proceed with the other one. Before proceeding to the reading of the next paper, as the result of our question box up to date, we have one question, and I will call upon Mr. Leyden in the hope that he may be able to answer it. "What is the watt gain in transmission on the line of the Cataract Power Co.? How do you explain it? Could it be possible that the line is crossed with the Radial Railway?" (Laughter.)

Mr. Leyden: Of course, most of you understand that there is no watt gain at all; there is a gain in the rise of electrical potential; we have a higher potential at this end than we do at the starting end; at no load it is ten per cent. and then it varies as the load comes on; the moment you equalize that by self induction due to transformers or motor load of any kind it disappears. There is no gain in watts at all, and the weight of evidence is that while you have 10 per cent. higher voltage on this end of the line, you have a current flowing into the line from the other end that may have 20,000 volts; we have about 18 amperes per phase on 2,000 volts, and it is shown that there is no load on this end at all, that the current coming in here just counterbalances the rise of potential at this end, and when we put a small load on this end the current at the other end still shows up about the same rate; that is, we can put say five amperes of current on this end and it won't increase the current at the other end at all, because there is the 18 amperes originally going in there, and that decreases as the load increases. There is still, however, with a very considerable load on, a matter of a thousand h.p., a slight rise in potential at this end over what it should be, but there is no gain in watts. There couldn't be. But it is a phenomena that is well understood and known as the Ferranti law, and it is figured out beforehand to determine the capacity of the line, and you know exactly what the effect will be. But there is no gain in watts at all, just an apparent gain in potential.

The President: We have a few other questions which have arrived, one is "Where is the proper place to begin charging customers for wiring—at the property line or inside of the building, or any other place?"

J. J. Wright: I should charge right from where it touches the building, then if it burns the fellow down he can't saddle you with the cost of it. Charge for the wiring the moment it touches the property line, that is, the building itself, or gets on the property of the consumer; it is his wire, and he is responsible for the safe keeping in every respect.

The President: What about the meter?

J. J. Wright: The meter, of course, would be excepted, but the wiring would be the property of the consumer.

A. A. Wright: The cut-out and the switch?

J. J. Wright: Yes.

Mr. Leyden: I should say that all property on the premises, beginning at the property line, should belong to the customer, with the possible exception of the meter, for this reason, that all fixtures on a property are subject to seizure for debts; anything that is attached to the property is subject to seizure. Of course, as to the meter, you put it on the property and you put it on at your own risk, but even that meter is subject to seizure for debts, as I understand it.

The President: In that connection I should do as was mentioned in an argument I had with a certain gentleman some years ago, have the charter changed, or perhaps better, have the law changed whereby the landlord would not have the right of seizure of the property of the company after they had been notified that the company had property on that building. I may say the charter of the Royal Electric Company was amended in that respect, and all we have to do now is to notify the owner that we have that property there subject to that law.

Mr. Leyden: What do you do in the case of a mortgage on the property?

The President: Send a notice to the mortgagor.

Mr. Gossler: I don't agree with the suggestion of Mr. Wright or Mr. Leyden, because in many cases you install primary installation, and you would hardly charge for primary wiring and transformer; I should suggest all secondary wiring attached to or on the premises.

Mr. Leyden: If you put it on there, you put it on at your own risk.

The President: The suggestion made by Mr. Gossler is one worth thinking about. As our business grows older and more extensive, undoubtedly it will happen that very frequently transformers will be placed in the buildings, and it would be a doubtful question as to whether you would want to sell your customer the transformer, whether you might not wish to retain the transformer in your own hands, and if so you would still have another piece of property on the premises. The danger apprehended by Mr. Wright that you are going to cause damage by your property or accident to life—I am afraid you would hardly be able to avoid that. If there are any conditions arising which would cause danger due to your fault, whether it be in wiring belonging to you or somebody else, you would undoubtedly be responsible for it. Mr. Dion, what would be your views?

Mr. Dion: The company should own, I think, all the primary installation. I do not see how you can avoid that. There is no question that in some cases it may involve you in a suit for damages, especially if the necessity arose for placing transformers inside the premises; as it is, I do not know whether that is being done in this country or not, but I know transformers are being placed in buildings in many places, and still I do not see how you can avoid owning and paying for all the primary installation. I should say that the company's responsibility should cease at the secondary terminals of the transformer.

The President: Still retaining the ownership of the meter?

Mr. Dion: Yes. I would like to sell the meter, but the conditions of meter practice are such, with the necessity of changing meters and that sort of thing, that you cannot very well do it. But, as a matter of principle, we should sell the meter. We should own nothing from the secondary terminals of the transformer inside.

Mr. Woolsey: I might say to the members of this Association that I have been in all the principal cities in the United States, and that the rules over there have been, regardless of where the transformer is placed, (the transformer is generally placed in the scuttle hole in the fore part of the basement, or else above the transom, above the stores or dwellings, or on the side of the dwellings,) that it has always been held as the property of the lighting company, the furnishing of the wires and running them into the building to the point of the meter. They also have a clause in their contract with the companies there that all material used belonging to the company, placed with screws, is always the property of the company furnishing the power; there is also a clause in their laws which says, that in case anything is placed with screws in the building, that is, not nailed, regardless of whatever may happen, and of how the trouble occurs, it cannot become the property of anybody but the person who put it there.

The President: How about the question Mr. Wright raised of the responsibility to the operative company for damage which may be done on the premises to the property of the company? Mr. Wright is speaking from personal experience on that point, I believe, and undoubtedly has good reason for what he says.

J. J. Wright: It is not only the damage, but the alleged damage. It just occurs to me, I have had an elaborate contract drawn up; it is not one that would scare a customer at all, but it has been very carefully drawn, and as a consequence of the study of several clever legal minds to cover this point of damage; and any member of the Association who has a mind to drop me a post card after I get back, I shall be most happy to send them a copy of it; it covers the point most clearly and as completely as it can be done legally. If I had thought I would have brought a few copies over. (Applause.)

The President: The next questions I have are: "Should rent be charged for meters? If so, what would be a reasonable rate?" "Should rent rates for power and light meters be the same?" "Should a higher rate be charged for larger than for small meters?"

J. J. Wright: We charge meter rent on all watt meters. The only kind of meter we use which we don't charge rent for (because it is only used for our own personal guidance), is the Edison electrolytic meter; but all watt meters and mechanical meters are charged rent for, the smaller meters at the rate of 25 cents per month, and the larger watt meter, direct current, at the rate of 50 cents per month. We find it necessary to do so on account of the large amount of repairs these meters take and the high original first cost. The consumers complain in some cases and say that the gas company does not charge for meters. They are thinking now of charging for them, however.

The President: The fact that you charge for it indicates that you think it should be charged for.

J. J. Wright: Yes.

The President: Do you make any distinction between power and light meters?

J. J. Wright: No, about the same price. There is also the government fee to be taken into account in charging for these meters the government inspection fee of $2, which also has to be paid out of this revenue.

Mr. Anderson: Do you charge meter rent on all accounts?

J. J. Wright: On all accounts where meters are used. There is no absolute hard and fast rule; there are exceptional cases, but the rule is to charge on all accounts.

Mr. Anderson: In our case in Windsor, if the account does not run to $5, I charge 25 cents; as soon as ever it reaches that point I drop the rate; when a meter earns that amount of money I can afford to throw that meter rent off. A meter rent is a very obnoxious charge, as you all know. The customer of course brings up the claim that the gas company makes no charge for meters. We have to meet that with the argument that the electric meter costs about three times what the gas meter does, and is subject to a great many more enemies. But there are a great many cases where it is very hard to charge a meter rent, and where you have accounts running $5, $10, $15, $20 and $30, a meter rent is not worth arguing with the customer for. If you get a meter rent on accounts running under $5 you are getting all that you practically require. The meter rent comes out of the people, I claim, the residential consumers. If you reach those customers by a meter rent, you are practically reaching, I claim, all that is required. Commercial lighting will generally run over $5, so that for commercial lighting we hardly ever get any meter rent; $3 a year is perhaps a pretty fair investment to collect on an $18 or $20 investment.

The President: Do I understand that $5, without rental for the meter, is regardless of the number of lights a customer has? If he had 100 lights and brought in \$5, would that warrant you in dropping the meter rent?

Mr. Anderson: As soon as his account runs to \$5 he would pay no rent for the meter. I do not care how many lights he had, as soon as his account ran to \$5 per month, I would charge him no meter rent. However, I believe the practice with a great many companies is that they charge on all accounts. In Detroit I find that the custom prevails very much as I speak of. I have followed them very closely, because their rates are similar to ours, and we can always meet the consumer in Windsor by stating that our rates are just as low as they are in Detroit, and that practically cuts off any complaints that we may have. In Windsor we use the Schallenberger meter largely. We charge a cent and one-half per ampere hour, with a discount of from 5 to $33\frac{1}{3}$ per cent.

J. J. Wright: You can afford to throw off the meter rent at that.

Mr. Anderson: I do not claim we can do as cheap lighting as Mr. Wright can in Toronto, or Mr. Hunt in London, but still we are not out for doing business for nothing.

Mr. Leyden: I think the proper business principle of running an electric light station is to make every department, if possible, pay for itself. A proper system of accounting should have a separate department for operating and maintenance of meters, and it is possible to make that department self-supporting. For that reason I think it is only fair and right that the customer should pay the rental of that meter, and I think that \$3 a year is a very small rental; I hardly believe it will reimburse the station manager for the expense of buying and maintaining that meter. What we usually do here is to fix a meter rental of about 20 per cent. of the cost of the meter for each year, whether it is a small or large meter. Lighting meters usually run about the same price; there is not a great deal of difference between a ten ampere meter and a large meter.

Mr. Hart: On what basis do you arrive at 20 per cent., charged to the customer on the meter as a rental?

Mr. Leyden: I always figure that you have to get about six per cent. return for the money invested, then the depreciation of that meter is easily eight or ten per cent., that makes 16 per cent; then for inspection and any incidental charges, 4 per cent. is a very small allowance, so that 20 per cent. will hardly pay you.

A. A. Wright: Our custom is where we put in meters from $7\frac{1}{2}$ to 10 amperes, we always charge 25 cents a month rental; and as the last speaker says, I believe every department should maintain itself. When you take into consideration the facts that you have to have a room to clean those meters; have to have a man to go around and clean them and look after them; and when you consider also that fire occurs frequently and you lose one or two meters a year, and when you pay for inspection and one thing and another to keep things in order, I don't believe \$3 a year is more than a good christian man can stand.

Mr. Leonard: I would like to call the attention of the convention to one matter which slipped through yesterday without creating any discussion, that was this matter mentioned by Mr. Browne in regard to a day load for lighting stations; he proposed an idea which it seems to me is a good one. The idea is this, to help out your day load and even up the curve and reduce the peak in comparison with the other parts of your load, by getting on customers that use power during the day at hours when you have no use for it for lighting. We have made a contract with the Royal Electric Company covering the use of 3,000 h.p. for power purposes, whereby we use the power only during such hours as it would not ordinarily be required for lighting; we have a perfect right to use the power any time during the summer up to seven o'clock in the evening. In the winter months we are obliged to shut down our power at four o'clock, which accommodates the lighting station to such an extent that they can utilize the same apparatus, the same lines and general equipment for power purposes, and then utilize it again in the evening for lighting purposes. I don't think our case is any different from the case of many others, and if our users had this thing presented to them in the proper light, I believe that a large amount of business could be obtained by local lighting companies in this way. It is a fact, I think generally recognised, that there is very little work done in a shop after the lights are lit; the quality of the work is inferior. I think we notice that in connection with cotton mills particularly. I am referring in this case to 3,000 h.p. in connection with the Dominion Cotton Mills Company of Montreal. Now, small manufacturers and such institutions as that would regulate their hours of work so as to enable them to use this cheap power, which, perhaps, they could not afford to use at the higher price they have to pay for it if they use it when it would be required for lighting. Lighting companies, on the other hand, can afford to let power under those conditions very much cheaper, because the same generating capacity and station equipment, as well as the lines, are utilized so as to make a double earning capacity. I would like to hear other opinions in regard to this, and create a little discusion on the subject.

Mr. Leyden: In connection with Mr. Leonard's remarks, I might say we have made quite a number of contracts here for power on the basis of which he speaks—that is, during certain months in the year, from the 1st of October to the middle of March; the customer agrees not to use power after half past four or five o'clock. Here we are a little differently situated to what they are in Montreal, in that the city time is about half an hour beyond the standard time; that is, the sun goes down here twenty odd minutes later than it does in Montreal, so that we carry our contracts about half an hour further on than they do in Montreal; but I find comparatively very little difficulty in persuading manufacturers to accept this method of buying power, because, in the first place, there are a great many manufacturers that shut down during the winter for a couple of weeks to take stock, and nearly all the manufacturers are running comparatively light during those months. The manufacturers here in town are largely iron manufacturers, and it happens, fortunately for us, that their light season is in the winter. While a great many have objected strenuously to the idea when it was first broached to them, when you have explained to them all the workings of the thing and the advantage on both sides, and the advantages of a cheaper rate for power, because you can make a very marked difference in your rate for power, taking all the advantages into consideration, it is not a very difficult matter to get them around to your way of thinking. We have made quite a number of contracts on that basis.

Mr. Dion: May I ask Mr. Leyden how he controls that. Have you separate circuits for them?

Mr. Leyden: We have to trust to their shutting down at the time the contract calls for. We have a strongly worded contract; if they use it beyond the contract we have the privilege of charging an extra price for what they use.

Mr. Gossler: In reply to the inquiry of Mr. Dion, I might say we have quite a number of contracts that apply to power users after four o'clock, and relying upon their honesty, it is comparatively an easy matter to determine when they do or do not use it, because we know the circuits they are on. This matter of using power before four o'clock, I presume, has been carried out a little further in Montreal than in any other town in Canada, at least, to my knowledge. And I may say that last winter, at the time of our very heaviest lighting load, our day load represented about 75 per cent. of the very highest peak load that we had at first. I think that was rather extraordinary, at least from the records I have been able to obtain, and at present our day peak load is very considerably beyond the peak load at night.

Mr. Noxon: I would like to ask these gentlemen who have had experience with the day load whether they have many requests from parties using power for running extra time, or an amendment to the arrangement to allow them to use it after four o'clock, which would materially affect the business of lighting? Because I infer that many manufacturers having made that arrangement would, at certain seasons of the year, find themselves hampered during a rush of business by having to shut down at four o'clock.

Mr. Leonard : I think I can give you an idea that will clear up what you have in mind, and relieve you as to the matter of interference of the two loads. If the contract provides that the manufacturer close down at four o'clock, I don't think there will be any difficulty in getting the load back again by 7 o'clock, and at 7 o'clock you have generally passed the peak of your load ; after those hours anything you can get is very welcome.

The President : I think, perhaps, I can assist that a little further by a personal example. We have one case of about 450 h.p. where their contract provides that they shall have the privilege of using about 450 h.p. during twenty hours of the day, and during the other four hours of the day the maximum of their requirements shall be 300 h.p., thereby getting about 33⅓ per cent. of their capacity in consideration of that reduction. By that means they get a very much lower rate for their 450 h.p. during the twenty hours and 300 h.p. during the four hours than they would otherwise be able to get, for the reason that the company would be obliged to get the full return on the 150 h.p. that was cut off as if they sold it in light, consequently the power consumer would have to pay a very high price.

Mr. Noxon : I would merely ask if this phase of the business would be advisable. The reason I ask this is, because we are proposing to go into furnishing power by making a contract. Would it be advisable in making a contract, provided they wanted to use the power continuously, which of course would be an object, to stipulate that we would make a provision that the hours from four to eight should be entirely exempt in any case ; that they could use the other twenty hours in any way they wished.

Mr. Leyden : That is a form of contract we use.

Mr. Wyse : I would like to ask Mr. Gossler if his day load is equal to his peak load in winter ? I understood him to say that his day load was equal to or greater than his peak load at night ; does that apply to the peak load in winter.

Mr. Gossler : If I remember correctly, I think I said that our day load last winter at the time of our very heaviest load was approximately 75 per cent. of the night peak load. Next winter we expect to be in excess of the night peak load.

Mr. Reesor : Mr. Leyden said a minute ago that it would make a material reduction to a customer. I would like to ask how much reduction do you propose to make between a customer that uses it from 7 to 6 and one that uses it from 7 to 4 in the afternoon.

Mr. Leyden : I don't know that I can give you any positive figures, but I figure it would be about 25 per cent. difference. It makes a very great difference to you. You can figure about how much your full capacity is, so much horse power delivered. If you can sell it twice, if you get 75 per cent. of the value of it for each time, you are getting 50 per cent. more than you would in the rates, taking it the other way.

Mr. Reesor : If a customer says I want 50 h. p., and I will agree to take it from 7 to 4, what percentage would you say ?

Mr. Leyden : 25 per cent., at least.

The President : In my address at the opening of the convention I took occasion to refer to this, for the reason that I regarded it as being probably the most important question for operating companies. In answer to the question put to Mr. Leyden just now as to the difference between the man who would use up to four o'clock in the afternoon, and another one who would require to use up to six, you can arrive at it by determining how much revenue you would get out of that amount of power during those two hours from lighting. Lighting during those two hours is a necessity, you can't get along without having the light ; therefore, assuming that you can sell electric lighting, how much revenue can you get from the lighting for those two hours out of that amount of power ? Having determined how much revenue you want from the power for the entire day, you will be able to know how much you can afford to get out of it during those two hours of lighting, and the balance devoted to selling the power at a cheaper rate. In other words, you have a given plant out of which you must get a certain return ; that certain return for lighting only must come out of those two hours. If you can get that return, plus 50 per cent., by selling the power during the rest of the day, outside of those two hours, evidently you can afford to sell that power for only 50 per cent. of what you get for the other two hours. I will now ask Mr. Plews to read his paper, entitled, "The Protection of Low Tension Wiring against Dangerous High Potential Currents." It is a short paper, but it is on a subject that is very likely to engage your attention very thoroughly, and it will, undoubtedly, call for a considerable amount of discussion. In order to assist Mr. Plews in the demonstration of his paper, and to enable him to answer any questions you may wish to put to him in a way that will appeal to you, Mr. Wickens has kindly loaned us a blackboard which we will have set up before you, and Mr. Plews can mark his diagram on that.

Mr. Plews then read his paper. (See page 162.)

The President : This is perhaps the most important paper that we have had for some time ; it is one that interests us all very keenly, and we must very highly compliment Mr. Plews if he has accomplished successfully the device which he has set forth here. It is something that should be immediately put into service if it is one that can be relied upon to accomplish what he says, and we certainly thank him very highly for bringing it to our attention.

(Mr. Plews at this point drew a diagram on the blackboard illustrating the apparatus described in his paper, and by means of it answered many questions which the members asked as to the method of use, its reliability, etc.)

The President : I think the most cordial thanks of this convention should be extended to Mr. Plews for exploiting what he has done so far, and even if it be not complete, it certainly is a step in the right direction, and we should certainly assist him all we can to accomplish the results desired, without introducing other elements of danger. I move that the thanks of the convention be extended to Mr. Plews. (Applause.) Now, we will hear from Mr. Leonard.

Mr. Leonard read his paper, entitled "Transformer Economy." (See page 154.)

The President : Gentlemen, it is too late to undertake any remarks to-night on this paper, but I think I can say that it is one that every one of us can take home when we get the printed form, read it over carefully and attentively, study it, and bring it to the attention of our associates in our companies. It strikes the key note of one of the most important economies of central station operating. I hope that to-morrow morning, after the election of officers, upon the resumption of the papers you will be prepared to take up the discussion of this paper thoroughly.

The convention adjourned at 4:45 p.m., to reassemble on Friday morning.

At 5 p. m. the members and friends were privileged, by courtsey of the Hamilton, Grimsby and Beamsville Electric Railway Co., to enjoy an excursion over the company's lines, 21 miles in length, traversing one of the most picturesque and beautiful districts of Canada. On returning to Hamilton a visit of inspection was made to the terminal station of the Electric Light & Power Co.

THE BANQUET.

Upwards of one hundred members and guests participated in the annual banquet. It was the first event of the kind held in the handsome dining hall of the New Royal hotel. The menu, as well as the service, displayed the skill of the management. The President, Mr. W. H. Browne, discharged in an acceptable manner the duties of chairman and toast master. The following gentlemen occupied places of honor : His Worship, Mayor Teetzel, Hon. J. M. Gibson, Hon. Mr. Shepherd, United States Consul, ex-President J. J. Wright, President-elect A. A. Dion, Mr. A. F. Pirie, ex-president A. B. Smith, Mr. Fred Thompson, Mr. John Moodie, Mr. John Knox, Mr. John Patterson.

The following toasts were duly honored: "The Queen," followed by the National Anthem; "Our Association," responded to by Mr. J. J. Wright, first President of the Association; "Our Guests," replied to by Col. Shepherd, U. S. Consul; "Our Rights and Wrongs," response by Mr. Stephen Noxon, of Ingersoll; "Hamilton, the Electric City," response by Mayor Teetzel; "The Press," response by Mr. A. F. Pirie. The proceedings were further enlivened by excellent instrumental and vocal music.

THIRD DAY.

The convention resumed at 9.30 a.m. President Browne called the convention to order, and said: Before proceeding to the normal order of business, I have a telegram which should have been read at our entertainment last evening. It is as follows:

"OTTAWA. For Banquet to-night. Report passengers carried by electric railways in Canada last year reached the 100 million mark. George Johnson, Statistician."

The President: The first business we have to attend to this morning is the election of officers, and for the office of President the Nominating Committee has mentioned the name of Mr. A. A. Dion, of Ottawa. (Loud and prolonged applause.) After that it is not necessary for me to ask for any other names. I think I can safely say, with the approval of the convention, that Mr. A. A. Dion will be our next president.

Mr. Dion was declared elected to the office of President.

The President: The Nominating Committee has offered for the position of 1st Vice-President the name of Mr. Geo. Black, of Hamilton.

Mr. Carroll: I have much pleasure in presenting the name of Mr. E. E. Cary, and in doing so call for a ballot. I think we need young blood and active workers in the Association.

The President: Mr. Carroll offers the name of Mr. E. E. Cary.

Mr. Leonard: I think I can heartily approve of the name Mr. Carroll offers, and of the suggestion that we need young blood; and while we all appreciate Mr. Black, those of us who enjoyed the hospitality of the rear end of the room last evening cannot help but feel that there is a possibility of a whole lot of young blood being proposed or offered by Mr. Cary, and to the intent that we may receive the sense of the Association in that matter I have pleasure in seconding Mr. Carroll's nomination.

Mr. Black: Will you allow me to withdraw from nomination. I would like to see the nominations go in unanimously. My nomination was a surprise to me at the time; I was not in the room yesterday when the committee reported, and if you place Mr. Cary in the position of 1st Vice-President you will have a good man there.

Mr. Kammerer: As Mr. Black, who is my choice as first Vice-President of this Association, has seen fit to withdraw, I desire to say a few words. The Canadian Electrical Association is an association of central station men, telephone men and telegraph men, and as such I cannot support Mr. Cary. Mr. Cary is a supply man; I am a supply man, and I think we should not take a leading part in the principal offices in the Canadian Electrical Association. As members of the Executive Committee, it is all right; we serve our place in that way, but as I said before, it is an association of central station managers, of central station people, of telephone people and telegraph people; let them take care of it, let the supply men step down and do the entertaining if you like; that is what we are here for. I have much pleasure in nominating a central station man whom I think you will all join me in saying is a good bright fellow, and that is Mr. Noxon, of Ingersoll.

Mr. Carroll: I think those remarks come with ill grace from our friend, Mr. Kammerer, for this reason, that he has been on the board himself, and he is a supply man; and I have been on the board myself nine years and I am a supply man.

Mr. Kammerer: I think our friend Carroll has misunderstood me. I spoke with reference to an executive officer of the Association—president, 1st vice-president, or 2nd vice-president. As members of the executive board I distinctly stated I would like to see supply men on it.

Mr. Leonard: I think Mr. Kammerer is making a wrong assumption when he assumes this is an Association of telegraph, telephone and electric light men. I think that the supply men, perhaps, make the largest contingent that we have with us, and if it was not for the support and strength the Association receives from the supply men, I think we would have a very uninteresting and very small society. Supply men have, of course, personal interests to work for, but I do not think that there is any member here who is in the supply business who would be elected to an office such as the first or second vice-president of this Association and would so bemean himself as to work that position for his personal benefit or for the benefit of his company. (Hear, hear.) I firmly believe that this Association should be run in the interests of central stations, and what is the interest of the central station is the interest of the supply man. Of course, we have heretofore had a number of central station men, representative men who have the management of the largest stations in the country, and it is difficult, I think, for some of the smaller central station men to fill this position so well as some of our supply men. The largest central station men have had their turn. I think now it is about time to give the supply men a chance, and see what they can do. Let us try it once.

Mr. Higman: I would say that the original intention, so far as I understand the matter, was that this Association should include all branches of applied electricity, and I have heard complaints made within the past year or two that there has been a tendency to make it wholly an electric lighting association. Personally, I have no objection, but if we are to maintain that broad character of the Association, I think we should keep in touch with the other branches, and personally there is no one in this room to-day whom I would sooner see in the office than my friend Mr. Cary. Those are my sentiments. I think we should try and keep the broad lines of the Association, and include all of them in its management.

Mr. Bonner: I would like to ask a question. If it were not for the supply men, how long would our good friends in the lighting business and in the telephone business and in the telegraph business continue in business, or when would they have gotten into business? If they are so dependent on the supply men in a business way and for the furtherance and improvement of all their interests, why can not the supply men serve an Association of electric light, telephone and telegraph men in the same manner? I think the whole thing works in together; we are interested alike for one common purpose, the improvement and success of the business as a whole, and why should we not work together in our Association?

Mr. Woolsey: As far as I am concerned personally, I have no objection to Mr. Cary's appointment as vice-president, but from years of experience in the electric lighting field among the various associations connected with it in different parts of the country, it has been found that the election of supply manufacturers or their employees, or the manufacturers of apparatus, as officers, from the president down to the secretary and treasurer, has never been found to the advantage of the Association itself; it has been tried time and time and again, and especially four years ago in the State of New York, it was tried to the detriment of the association—not that the men of the supply department or the manufacturers are not men who are responsible and capable of holding those positions, but it was found to be a detriment. The people in connection with lighting companies are men who are just as intelligent as the men who are representing manufacturers. I believe we can find to-day men amongst those who are representing the electric light companies who are as capable as we to fill those positions, and it is no more than right that these men be given the privilege before the men outside are taken in. It is well enough for us to take a part and to assist in every possible way, but as to our taking an active part in these offices, I think it is entirely wrong.

Mr. Dion: I Wish to say that I am sorry this question was raised at all. Until now I think the question of a division between supply men and central station men was never raised. I think it is a mistake to raise it ; this Association is not old enough or large enough to draw any lines between any classes of members; we want all the members, we want their assistance, we want their work. This association has two principal objects, one is the furtherance of the interests of the companies which the members represent generally; the other is the acquirement of knowledge in our calling. We know that for both of these objects, and especially for the last one, we have to depend in a very large measure on supply men. The papers which are read here and which contribute so much to the increase of our knowledge, are generally the result of the study and experience of men engaged in manufacturing, or the supply men. Then if you admit that we owe a considerable part of our success and the success of our Convention to the efforts of the supply men, if you put them on your committees and get them to perform the work of the Association as they have done, some of them in such an efficient manner, is it right to debar them from the only little reward we can offer them in the way of honors? I do not think it is fair ; undoubtedly it would be wrong to allow men, if they must be considered apart from the other members as a class, to control the affairs of the Association to the exclusion of the station men. There is no question that that would be wrong, but I do not think there is any danger of that for some years to come at least, and in the meantime I should like that we should forget that there is any division between us whatever. (Applause.)

Mr. Bonner: I should like an opportunity to qualify a statement I made to this extent. It is possible the members here may have understood or inferred from what I stated that I had an impression that station men and telephone men and telegraph men were not as equally capable of developing the business as supply men; that was not my meaning at all. It is simply this, that we are in the business of supplying apparatus, and even so, we are at the same time greatly dependent upon the station men to give us ideas regarding the practical effect or operation of what we supply, and to that extent we are dependent upon them, but it is simply the working together of the two interests that makes us, as I feel, equally interested in the success of this Association.

Mr. Kammerer : While it may not be written in the laws of the Association or in the by-laws of the Association that supply men are not competent to hold the position, yet it is the unwritten law, and one in which the older members that are here now will bear me out in (I refer particularly to Mr. Yule, Mr. Black, Mr. J. J. Wright and Mr. Thomson), that it was always understood to be an Association of central station managers, telephone people and telegraph managers, and those actively interested in that business, and not of supply men. While Mr. Dion says he has never heard the question raised before, I may say I have attended the Association since 1892 I think eight or nine meetings —and at three of those meetings I did hear it mentioned and discussed; and finally settled with the old members, that it was not the thing for supply men to hold the position of president or first or second vice-presidents.

Mr. Yule : Mr. Kammerer was vice-president one year himself.

Mr. Kammerer : Let me set you right there. At the time I held the position I was proprietor of a central station.

Mr. Carroll : I would like to say this, that that sentiment has really crippled our Association to some extent, and you have crippled your telephone interests and your telegraph interests by just such remarks as those from Mr. Kammerer. Why should we draw the line between the telephone and telegraph and central station and the supply men ? What he says sounds very nice, but it does not follow out in the history of this Association. I have been a member nine years and I know the history of it. You have crippled your telegraph interests and your telephone interests, and if you continue on with your supply interests you are going to have fewer members than you have got here now.

The President : As between Mr. Carroll and Mr. Kammerer, it would appear that the withdrawal by Mr. Black of his name takes out of the discussion the question of distinction between telephone and telegraph men and the supply men, and the nomination of Mr. Noxon leaves the question entirely between central stations, electric lighting stations and supply companies. Mr. Black has withdrawn, therefore I think any further reference to the question of telephone and telegraph men has been taken out of the discussion by Mr. Black's own action. The situation would now appear to be as between the supply department and the operators of electric lighting stations.

Mr. Higman : I think it is a little unfortunate to make that division. I would lose sight, if possible, of the occupation of those who have been nominated I would not say it was between the supply men and electric light men.

The President : I will accept Mr. Higman's correction. The idea that I had in mind was that Mr. Black, by having withdrawn his name, took out of the discussion the question of telephone and telegraph interests, but Mr. Higman is correct in saying that it is not a question between supply men and electric lighting companies, but it is a question of having all interests represented. Therefore I will withdraw my remark.

Mr. Leonard : I move we proceed to ballot.

Mr. Noxon : I feel it a great compliment to have my name mentioned in connection with the Vice-Presidency of this Association, but I hope further that my nominator will do me the justice do me the kindness, at any rate of withdrawing my name from connection with this position. I certainly would feel that I would be under great obligation to the Association were my name acceptable to them in that capacity to serve to the best of my ability, but at the same time I do not feel that I have any claim whatever upon the consideration of this Association for such an honor as that, and I would therefore kindly ask my nominator to withdraw my name from the convention altogether.

Mr. Gossler : I second Mr. Leonard's motion to bring the question to a ballot.

Mr. Carroll : I cannot see how you can have any ballot, as there is only one name before the Association; Mr. Noxon has withdrawn his name.

The President : I cannot agree with you ; Mr. Noxon has only asked that his nominator withdraw his name, but Mr. Noxon has not withdrawn himself. Before I put the question I desire to know if there be any other nominations desired to be proposed for the office of 1st Vice-President ?

A. A. Wright : Will you allow me to draw the attention of this Association to one thing—that this tempest in a tea pot has not been raised by central station men.

Mr. Anderson : Mr. President, I am only a new member of this Association ; this is the first convention I have attended ; I have never heard of the jealous feeling that is said to exist in this Association. I wish to endorse what the last speaker said I do not believe it comes from the central station men. I regret very much that the remarks have been as pointed as they have been. Perhaps I may strike the key note when I say it may arise from a little jealousy on the part of the supply men, because I do not believe it arises from the central station men. As far as the success of this Association is concerned, it depends largely, sir, on the manner in which we hold together. As far as the supply men are concerned, I think they are linked together with the central station men, and we cannot deprive them of their right as members of this Association to hold office and get part of the honors, while I believe it would be in the interests of the Association to divide these honors fairly and equally. I just wish to express my sentiments in this way, that in union is strength ; do not let these jealousies creep into our Association and thereby injure it. There is no supply man on the floor but what I would welcome and be glad to see hold one of the offices of this Association. My acquaintance with Mr. Cary is limited, but I think he would make a splendid man for the position, and as a central station man I have no hesitation in supporting any supply man for one of the vice-presidencies of this Association.

Mr. Kammerer: One word. My motive has been questioned by Mr. A. A. Wright, of Renfrew. My motive was to carry out what the Association was originally intended for and started for, and I challenge Mr. Wright to prove or to say that I am not right in what I am contending for this morning.

Mr. Carroll: I challenge him, for he was one of the officers, and was a supply man at the time. (Cries of question, question.)

A. A. Wright: I suppose I have the right of reply to Mr. Kammerer.

The President: You have the privilege from the President of replying.

A. A. Wright: I do not want anyone to think that I was casting any slurs upon Mr. Kammerer, but I merely wished to draw attention to the fact that central station men were anxious to have this thing run evenly, smoothly and nicely, and I believe Mr. Kammerer is acting in good faith and is speaking what he believes; I do not doubt it in the least. Whether he is right or wrong is a matter for us to decide when we vote, and it is not necessary for us to go into this thing particularly, but vote as we like and have no disturbance.

Mr. Carroll: There is a second nomination for 1st Vice-President; I have not heard it seconded.

The President: I was not aware it required to be seconded, but that there may be no question——

Mr. Thomson: I second it.

The President: Before I put the question, I desire to say, the position of the President in this matter is rather different from what it is on matters ordinarily before the convention; and I hesitate to make any remarks whatever, and will absolutely refuse to express my opinion pro or con. On everything else except the nomination of officers I, during the time that I have been and will be President, propose to have my say, and I think I have exhibited that tendency in this convention, but I do wish that the result of this vote shall be, not the creation of any ill-feeling, not the creation of any severance, but the cementing together of all the interests belonging to this Association. (Applause.) I would have preferred that the candidates for this office should have been confined to one name, or if there must be more than one name, several names; and I was rather pleased when I found that Mr. Black had been proposed by the Nominating Committee, and that Mr. Cary had been proposed by independent nomination. The issue would have been better for all of us if Mr. Black, Mr. Cary and Mr. Noxon had been offered for our votes, but as Mr. Black has withdrawn, the question is left for you now to decide as to whether you believe it is desirable in the interests of the Association that a man who is representing an operating company, or a man who is representing a supply company, both of them personally very popular men, shall represent the interests of this Association in an official capacity. Now, gentlemen, the ballot will be taken by each one writing the name of his candidate upon a piece of paper, and I will appoint as tellers Mr. Black and Mr. Anderson. Associate members are not entitled to vote, therefore when the tellers pass around and receive the ballots of each one, you will kindly see that they are active and not associate members. Gentlemen, in order to facilitate our progress this morning, while the tellers have your votes for 1st Vice-President before them for consideration, we will take up the question of the election to the office of 2nd Vice-President, and the name presented by the Nominating Committee is Mr. P. G. Gossler, of Montreal. (Applause loud and prolonged.)

The President: I cannot find anybody who has got the name of anybody else; therefore Mr. Gossler is 2nd Vice-President. (Applause.) The names presented by the Nominating Committee for members of the Executive Committee, for re-election from the old board, include that of Mr. E. E. Cary, who has been ballotted for for the office of 1st Vice-President. Should it occur that he will have a majority of the votes for that position, some other name will require to be presented for the Executive Committee; therefore I will at the moment offer for your consideration only four names of the old committee: Mr. J. J. Wright, Toronto; Mr. A. B. Smith, Toronto; Mr. Ormond Higman, Ottawa; and Mr. John Carroll, Montreal.

Mr. Higman: I would ask you to withdraw my name; I have been on the committee now for a long time, almost since the flood I was going to say—since the formation of the Association —and I would like to give place to somebody else.

The President: Mr. Higman can only give place to somebody else on this occasion by nominating somebody else.

Mr. Wickens: I would like to nominate Mr. Black to fill that position.

Mr. Carroll: While I would like to see Mr. Black on the committee, he has got to go in on the second ballot. Under the constitution we have to elect five of the present board.

The President: I have mentioned the names of only four of the five because Mr. Cary is under consideration by the tellers for the office of 1st Vice-President. In order to make the road clear for the election of five gentlemen of the old board, I can announce now the result of the vote for the office of 1st Vice-President: Mr. Noxon has received 26 votes, Mr. Cary 29. Mr. Cary therefore is declared to be, by the choice of this convention at present assembled, 1st Vice-President for the incoming year. (Applause.) Now, therefore, we have to consider for the Executive Committee entitled to be re-elected from the old board: Messrs. J. J. Wright, A. B. Smith, O. Higman, John Carroll, and one other, and Mr. Wickens has nominated Mr. Geo. Black. Are there any other nominations?

Mr. Cary: I would request Mr. Higman to give his consent to serve, because we will be in Ottawa next year, and outside of the great value of Mr. Higman's services in the past, and what I know they will be in the future, I hardly think he realized that we were going to meet in Ottawa, and really we cannot possibly get along without him. I know that from past experience, and if he will only kindly consent to serve I think we will all feel grateful to him.

The President: I didn't take Mr. Higman's remarks in earnest at all. (Applause.)

Mr. Higman: I was going to say that I will serve in any case whether I am on the committee or not. My idea was to give a chance to those who had not had the opportunity hitherto, but if it is the desire that I shall remain on for this year, I certainly will.

The President: Then the names presented to you now are: Messrs. J. J. Wright, A. B. Smith, O. Higman, G. Black, and John Carroll for the Executive Committee consisting of five members to be re-elected from the old committee. (Carried, amid applause.) Now for the five other members of the Executive Committee. And right here, gentlemen, I want to say that, with the exception of Mr. Carroll, Mr. Kammerer and Mr. Wickens, you seem to have forgotten the fact that everyone of you are entitled to nominate somebody else if you want to, and in this case I want somebody else to nominate another fellow. The names presented by the Nominating Committee are: Messrs. D. R. Street, Ottawa; A. Sangster, Sherbrooke; J. F. H. Wyse, Brantford; B. F. Reesor, Lindsay. Now for the last name on this list I want somebody to substitute another for, and that is Mr. Browne, of Montreal. As Mr. Higman said, Mr. Browne of Montreal can be of some value to you if he is not a member of the Executive Committee, and I think from what I know of him he would be really of more value to you if he was not on the Executive Committee, because he has not very much time to devote except in an entirely unofficial way. When I can give the time I can give it and will give it, as I have in the past, freely and willingly, but for official occasions it is not always convenient for me, therefore I ask somebody else to nominate someone in my place.

Mr. Wyse: With all due respect to your request, Mr. President, I think it is to the benefit of this Association that this Association take your request as you took Mr. Higman's, not at all in earnest.

The President: And as Mr. Higman did, I will do likewise. (Applause). It is so much a matter of course and so much the regular thing that the nominating committee omitted to put on this document any officer or any name for the position of Secretary-Treasurer, and I, following their example and realizing that there was no other thing to be settled, forgot to say that we had to elect somebody for the position of Secretary and Treasurer.

(Cries of "Mortimer." Carried amid applause.)

The President: It was not necessary to put it on paper.

Voices: "No." (Applause.)

The President: We have but a very short time left to us this morning, and I suggest, if it meet with your approval, that instead of discussing Mr. Leonard's paper now, that we have read first the other two papers that are stated on our programme, and if we have time then we can discuss all three of them practically as one. While they are not of the same kind or character, yet they all refer to the technical line of our business. I would like to have nearly a day and a quarter left to discuss Mr. Leonard's paper, and I have no idea how much time I would like to have left to discuss Mr. Cary's paper, and I am sure as far as Mr. Turbayne's paper is concerned you will all employ the next few weeks in discussing amongst yourselves the value that it represents to you as operating men, because I presume that in the very near future the question of long hour burning arc lamps will be the most practical one we will have to deal with. I will therefore ask Mr. Cary now to read his paper on the incandescent lamp.

Mr. Higman: Before dealing with the system of arc lamps, I would like to place a resolution before the Association so that it will go in with Mr. Leonard's paper. During the last few years our officers have been greatly bothered to arrange settlements between electric lighting companies and municipalities in respect of arc lighting. Frequently—too frequently, indeed—the contract is made in the terms of "candle power," a lamp of 2000 nominal candle power. That may mean something or it may mean nothing; I am inclined to the latter view of it, because it is extremely hard to determine the actual candle power of an arc lamp; it is dependent on so many things; so many conditions of the lamp when it is in operation arise that it is almost impossible to make a correct measurement of the light. There is the angle at which you take the light to be considered; there is the purity of the carbons, the mechanism of the lamp and several other things, the length of the arc and the time that the measurement is taken. And you all know that it is almost impossible to get a correct measurement of the candle power. So that in those cases where "candle power" is stated in the contract, we have been able to give little or no assistance. In other cases where the contract has been made in the terms of volts and amperes, we have been able to do something. I might cite a case. In Toronto a couple of years ago the municipality retained something like $18,000 of the company's money under the plea that they were not getting what the contract said they should get. After a good deal of wrangling I was called in by both sides, and after testing the various circuits and a large number of lamps, and travelling all over Toronto for a couple of nights until daylight, I made my report, and found that the company was not only fulfilling its contract, but had been supplying 25 per cent. in excess of what the contract called for. This was borne out by the measurements that had been made by the city electrician, whose report or statement they refused to accept. Now, the consequence of that report was this, that the $18,000 was paid over the next day. So you will see, if we have a means whereby we can determine what is being done, it will work out to the advantage of the electric lighting companies. I might say in passing, that at Ottawa at the present moment there is one of these disputes going on. The erudite city solicitor there has stated that a nominal 2000 candle power lamp means an actual 2000 candle power lamp. How he makes that out, I leave him to determine. The resolution I move is practically the same as was adopted by the National Electric Light Association of the United States, and it has been found to work well there during the last four years since the arc lighting came into vogue.

I will move, seconded by———

"Recognizing the difficulty, if not impossibility, of measuring with any degree of accuracy the illuminating power of the arc lamp, and the great necessity for a more precise definition and statement of the obligation of the producer of electricity for illuminating purposes to the consumer thereof, be it resolved, that in the opinion of this Association, what is ordinarily known as a two thousand candle power arc lamp is one requiring on the average four hundred and fifty watts for its maintenance, the measurements being made at the lamp terminals, where no sensible resistance is included with the arc. In case such resistance is used, it must be excluded in the measurement."

Mr. Henderson: I second that motion; I think it is a move in the right direction.

Mr. Gossler: I would like to ask if that resolution is not just a little incomplete. The advisability of placing more lamps on the street of a smaller candle power is very seriously considered in many large cities, and in some cities has been adopted, and to simply confine this to the 2,000 candle power lamp I think is a little incomplete. I also think this is a resolution that will stand consideration and deliberation of longer standing than passing this resolution hurriedly in this Association. 450 watts at present seems all right, but I think it would stand consideration. I would not like to see it passed hurriedly.

Mr. Higman: Of course, it will not be obligatory for anyone to adopt that as a means of making their contract, and the 450 watts only serves as a basis; there can be no objection to add a proportionate part of that for any arc lamp. Of course, if the Association were to pass this resolution it would then be a matter for consideration to be determined whether the government should give it the stamp of an Order-in-Council, so that our men might act with some standing in the matter. I am quite willing to let it stand as a notice of motion until next year.

Mr. Thomson: 450 watts straight current will give more light than 450 watts alternating current. I believe, according to the measurements, there is at least 200 candle power difference between the alternating lamp using the same watts as compared with the straight current, so that in stating 450 watts, it should be stated whether it was straight current or alternating; and there is a lot of difference between the enclosed arc lamp and the open.

Mr. Dion: Since this is a question that, as Mr. Gossler has said, deserves careful consideration, especially as it may form the basis of an Order-in-Council which would go out throughout the country and have to be accepted as law, would it not be better to appoint a committee to make a report at the next convention. It is true it would delay the matter for twelve months, but in those matters it is better to go slow than to make any mistake. A committee of two men could be appointed to consider the matter carefully during the year, and make a report at the next meeting which would be adopted or rejected.

Mr. Turbayne: I think the lamps under the candle power system can be read on the wattage basis, and I think they are.

The President: As I understand the purport of Mr. Higman's proposed resolution, it is not the establishment of a fixed quantity of energy for a defined candle power, but to have this Association give its sanction to the adoption of the idea that candle power as an element of measurement shall be abolished, and that measurement in energy shall be the basis of a contract; and I believe, and I submit it to you for your thoughtful consideration, that if Mr. Higman will modify his resolution in this respect, and instead of referring to 2000 c.p. or to 450 watts, make the resolution to read "that the basis of contracts shall be upon the basis of energy supplied," we can all agree with his resolution immediately. We do not have to appoint a committee, we do not have to wait a year, we can settle the question now; that is, that this Association recommends not only to its own members but to the governmental authorities, that in making a contract for service it shall be upon the basis of energy supplied to the lamp, regardless of what nominal candle power or actual candle power may be, and I request, if that meets with your approval, that Mr. Higman modify his resolution in that respect, and in that respect, if it is approved by us, I think it will undoubtedly form the basis of future contracts with municipalities.

Mr. Dion: While there can be no objection to the motion, altered as you suggest, it would hardly cover the ground. If I understand Mr. Higman right, he refers to contracts that are already made, as well as those to be made.

Mr. Higman: No, you cannot affect them.

Mr. Dion: Suppose he wanted some definition of what a 2000 nominal c. p. lamp meant, so that he could determine———

The President: I don't understand that to be Mr. Higman's idea.

Mr. Higman: No; it is to deal with contracts when they come up in future.

Mr. Gossler: I agree with Mr. Dion, and repeat what I said, that there are so many things to be considered that I do not see how you can make this matter the subject of a resolution to be passed now. When we say "on the basis of energy", where is that energy going to be—in feeding the mechanism or the arc?

The President: Mr. Higman's resolution is, energy yielded to the lamp.

Mr. Gossler: That opens the question right away, where is your energy going to be consumed? You may have one-half of that energy used in the mechanism of the lamp. The object of the lamp is light, not having the energy consumed in the mechanism. I don't see how you can make this the matter of a resolution to be passed hurriedly. It means an awful lot of trouble if you do, in my opinion.

Mr. Noxon: I quite agree with the last speaker, and also with Mr. Dion, that it would be far better to leave this matter over and have whatever is done done upon such a basis that there will be no injustice in the future. What I would be afraid of would be that any resolution passed by this Association would be taken as authoritative by the government, because this is the highest electrical authority that we have in the country as a body of independent individuals; they would naturally assume that whatever legislation this body made with reference to matters of that kind, would be an indication of the wishes of the electrical fraternity throughout the country, and it probably might be crystalized into law. If that is the case, it is better before such a thing is done that we know exactly the ground we are taking. It may be that it is all right; I am not particularly familiar with it. I am interested in this question from the fact that I am one of the parties having contracts with municipalities, and, of course, you can't get municipalities to understand what is meant by watts; in all their dealings, so far, through the nominal candle power, they have a sort of an idea, although very hazy, what that means; and when you come to get them to accept the thing in watts, a thing they know nothing about, you will have difficulty in convincing the authorities that you are not trying to take some advantage of them.

Mr. Higman: I brought this matter up casually before in Montreal with a view of having the Association take it up. We do not want to interfere or legislate in the slightest degree, but we are called upon to settle these disputes. Now, as a matter of fact, the so-called 2000 candle power gives only from 500 to 700 candle power. It is better to call a spade a spade and not say it is an axe.

Mr. Wyse: I would like to move that a committee be appointed to deal with this question. It is too serious a question to be disposed of by motion hurriedly. It immediately appeals to a central station man; that is, the great advantages of it appeal to the central station men. in the idea that you give 450 watts and receive pay for 2000 c.p. regardless of how that energy is consumed and the amount of light; but, unfortunately, there are two parties to the contract. The other party is the municipality, and what they judge, regardless of nominal candle power or actual candle power, or watts, or anything else, is the amount of apparent light or useful light they get from an arc lamp, and that is going to be their basis of contract. They would immediately inquire as to why the alternating current arc lamp, taking 450 watts, was not giving as much light as the direct current arc lamp, taking the same amount of current; and where you might make that a basis you would have to refer to the apparent candle power represented by a given number of watts, that is, you would have to refer to something that would appear to the people a given amount of light; 450 watts, whether alternating current or direct current, would have to represent to the people a certain amount of light which they could understand or see. I move that a committee be appointed to deal with the question.

Mr. Thomson: I second the motion.

Mr. Higman: I fancy my position in this matter has not been quite understood. I have simply brought it up in order that our inspectors might be of as much use as possible in trying to straighten out the little kinks that electric lighting companies have in many cases; that is the sole object. If the Association is not prepared to take the matter up, I will withdraw the motion and you can take it up at some future time.

Mr. Yule: I remember some years ago Mr. Higman brought this matter up and the discussion was much the same. He recommended then that all contracts that were afterwards made should be made on the basis of energy. We attended to that in Guelph, and had it fixed in that way on the suggestion of Mr. Higman.

The President: I understand Mr. Higman's motion just as he has offered it, I think, that is, he would like to have first determined a measure, approved by central stations in body asssembled, by means of which his employees could interpret not only future contracts, but perhaps present contracts. I recognise that Mr. Higman is in a difficult position because a great many contracts recite that the light furnished shall be of so many nominal candle power. It would facilitate his work a great deal if it were possible to have an expressed opinion from us that a nominal 2000 c.p. arc lamp should not require at the terminals of the lamp more than 450 watts. The point raised by Mr. Gossler that 450 watts may be consumed to the extent of two-thirds in the mechanism of the lamp, and that only one-third shall be applied for useful effect, does not, I think, coincide with Mr. Higman's idea. His purpose, as I take it, is that the 450 watts of energy delivered to a lamp shall be employed by a lamp of the very best character of construction obtainable to-day, so that the maximum of the resultant energy shall be given to the municipalities by the company who delivers 450 watts to the lamp.

Mr. Leonard: Measure the energy across the arc and I think you will get rid of the difficulty.

The President: I take it that Mr. Higman's purpose here is to obtain some defined plane upon which the government, the municipality, the private consumer and the company may meet without any possible chance of error or equivocation; and while it is desirable, as suggested by Mr. Dion, Mr. Gossler, Mr. Wyse and Mr. Thompson, that we be not hasty in determining what candle power may represent in energy, I do believe that we should now support Mr. Higman in some declaration to the effect that energy shall be the basis of calculation on which future contracts will be made, and if possible the basis upon which old contracts may be interpreted.

Mr. Thomson: I believe that 450 watts from carbon to carbon between the carbon points of an arc lamp would give what is known as 2000 candle power nominal, straight current—450 watts between carbon points with a series arc lamp or straight current arc lamp.

Mr. Higman: The difficulty, of course, is not so much that I want to state what the actual voltage of the lamp should be, but that the energy shall be the basis of the contract, so that we may have some ground to stand upon. This matter came up in Chicago in 1893, in an almost similar resolution to this, to make it the standard of arc lighting. There are many reasons why you cannot make an absolute concrete standard unless you eliminate two things; first the quality, that is, the purity of the current, and the mechanism of the lamp; those would not be eliminated in that resolution and consequently we could not make it an absolute standard of lighting, but we are dealing now with the practical question of supply. Assuming that the carbons will be good and the lamps good, if energy under those conditions is applied to the terminals of the lamp, we will get in 99 out of 100 cases the nominal 2000 candle power. But the important point is to bury out of sight for all time the words "candle power" in regard to arc lamps.

Mr. Wyse: I would like to ask Mr. Higman whether he insists on withdrawing his resolution?

Mr. Higman: Or you might refer it to a committee.

Mr. Wyse: That is what I think might be more advisable.

The President: I understand the position now is, Mr. Higman has withdrawn his resolution?

Mr. Wyse: No, he has not; he allows it to stand, and I make a motion that it be referred to a committee, and the motion is seconded by Mr. Thomson.

Mr. Higman: Allow me to move that the committee be comprised of Mr. Gossler and Mr. Thomson.

The President: As I understand the position now, Mr. Higman withdraws his original resolution in the form he presented it, but offers a new resolution in lieu thereof, that the subject referred to in the resolution here proposed, be referred to a committee consisting of Mr. Gossler and Mr. Thomson, who will report to this Association at next convention what, in their estimation, is the best means of meeting the question at issue. Am I right, Mr. Higman?

Mr. Higman: That is the whole question.

Mr. Noxon: Seeing that the convention is practically unanimous upon the main issue—that is, making the energy the basis—would it not be better for Mr. Higman to make his resolution to that effect, and leave the question of what that shall be to this committee?

The President: I will take the liberty of answering that. The committee are now given broader powers than that; that is, they take up the entire question, and they make their recommendation in any particular they deem necessary.

Mr. Higman's motion is presented.

Mr. Yule: I think the gentlemen here do not sufficiently recognize the courtesy they receive from Mr. Higman in this matter. He has brought this up more than once, and is apparently not anxious to take any action but what would meet with the approval of the Association, and I feel he has received scant courtesy.

Mr. Higman: Not at all.

Mr. Yule: We ought to work in with him better than we are doing. I second the motion.

The President: I tried to take away the atmosphere of scantiness of courtesy by endeavoring to interpret Mr. Higman's desires, and I believe the rest of the members of the Association here appreciated the fact that I was interpreting Mr. Higman's intention to deal fairly with this Association and the members of operating companies.

Mr. Thomson: I believe Mr. Higman should be on that committee.

Mr. Higman: Let the mover and seconder be on the committee.

The President: The motion is before you, that a committee be appointed, consisting of Mr. Higman, Mr. Gossler, Mr. Fred. Thomson, Mr. Yule and Mr. Wyse, to consider the question of the interpretation that should be given to the delivery of current for arc lighting and to report at the next convention their recommendations in that respect.

Mr. Higman: Might we not have it "for the purpose of rating arc lamps on a basis of energy"—that would cover the whole thing.

The President: All right.

The motion carried.

Mr. Carroll: Under the head of General Business, I would move that the papers be held as read, and printed and incorporated in the proceedings of this convention.

The President: I object to that emphatically. (Hear, hear.) These gentleman have gone to the trouble of writing these papers for us, and in one instance I know that the chairman of the committee on papers, in order to supply us with papers, took upon himself the task of writing a very important paper; it would be very scant courtesy indeed for us to adjourn now without those papers being read.

Mr. Yule: I move that the thanks of this Association be cordially voted to the Mayor and Corporation of the City of Hamilton, the Press, the Grand Trunk and Canadian Pacific Railway Companies, the Hamilton Street Railway Co., the Radial Railway Co., the Hamilton & Dundas Railway Co., the Hamilton, Grimsby and Beamsville Railway Co., the Cataract Power Co., the Hamilton Electric Light Co., the proprietors of the New Royal Hotel, the Local Committee, and others, for courtesies extended in advancing the interests of this convention.

Mr. Leonard: I second that.

(The President put the motion, which was unanimously carried.)

The President then called on Mr. Cary to read his paper. (See page 160.)

Mr. Cary: Owing to the short amount of time at our disposal, may I request you to allow Mr. Turbayne to read his paper in advance; Mr. Turbayne has written that paper at my special request.

The President: Mr. Cary is our next 1st Vice-President and we will be glad to do anything he asks.

Mr. Turbayne read his paper entitled "Long Burning Enclosed Arc Lamps," (see page 159), which was greeted with applause.

Mr. Cary: In moving a vote of thanks for Mr. Turbayne's paper, I think the members would be interested to know that in response to our President's request upon central station men for subjects upon which they would like papers written, a number of replies were received, requesting a paper on the enclosed arc lamp and its use, and therefore I was particularly anxious this paper should be read. I suppose my turn comes next, and as I have received honor enough from the committee on papers, and as the inner man is entitled to something before we leave, I wish you would kindly excuse me from reading it and trespassing further upon the patience of our members. If there is anything valuable in the paper it is tabulated there in clear form. I am sorry to disappoint my good friend Mr. Gossler, who has his keen knife all ready for me when we got into discussion, but I think it would be wiser to allow the paper to drop.

The President: Some people have suggested that as Mr. Cary is so good natured and so willing, as he always is, to work hard, that he will read this paper on the train on the way down to DeCew Falls, but I hope when we leave here now we will leave to enjoy ourselves. When we leave, our business of this convention will be closed; there will be no opportunity of reopening it until the next convention, and my duties and my opportunity of talking to you as I have just now will cease. I only desire to say in closing this convention that I have not had in all my lifetime's experience, and it has been somewhat varied, as grateful an opportunity of realizing the good fellowship and the thoroughbred honesty of purpose of people who may not always agree with me, as I have found since I have been president of this Association. You took me up last year and unanimously, as you have for my successor, appointed me; it was a surprise, and if I had had time I would have refused. I have tried to do my utmost for the Association, but I have not been able to do all that I should do or wished to do, and I am particularly gratified that my successor is a man who will be able (and if he is not able he will find the opportunity to be able) to fulfill all the duties of President of this Association. I now resign in favor of Mr. Dion. (Applause).

The newly-elected President, Mr. A. A. Dion, took the chair amid applause and said: Gentlemen, I do not propose to detain you at this late hour except to say that I am exceedingly grateful to you for the honor you have conferred upon me. I do not know that I ever did anything to entitle me to this honor, except in taking an active interest in the affairs of the Association, and in being a thorough believer in the usefulness and value of the Association. You can understand that following in the footsteps of Mr. Browne, after what you have seen of him during this Convention, I have not an easy task to perform, if I am to be judged by the standard which he has set. However, you may be assured that whatever little ability or knowledge I may possess will be applied industriously to the interests of the Associotion, and what I may lack in those qualifications I shall endeavor to make up in zeal, and zeal born of a thorough faith in the value of the Association. I thank you very much for the honor you have done me. (Applause.)

Mr. Higman: I beg to move, as briefly as possible, that this Association tender to the retiring President a hearty vote of thanks for the very able manner in which he has filled that office during the past year. (Applause.)

Mr. Dion: Might I be allowed to suggest that we include the names of the other retiring officers.

Mr. Higman: Yes.

The President, Mr. Dion, put the motion, which, on a vote having been taken, was declared carried unanimously, amid loud applause.

The Convention closed at 12.15 p.m.

Friday afternoon was spent as the guests of the Cataract Power Co. in making an inspection of the Company's extensive electric power development works at DeCew Falls.

NOTES.

It was fitting that the two pioneers of electric lighting in Canada, Mr. J. J. Wright, of Toronto, and Mr. Fred. Thomson, of Montreal, should occupy prominent places of honor at the banquet.

Several attractive and useful souvenirs of the convention were in evidence, among them being a nickel plated pocket match-box, having celluloid sides on which appear the name of the Royal Electric Co. and views of the Cataract Power Co.'s generating station; a stickpin surmounted by a miniature incandescent lamp and a union jack in the form of a bow, the gift of the Canadian General Electric Co.; a pen knife and case bearing the name and compliments of the Packard Electric Co.; a diamond-shaped eraser by the Canadian Rubber Co.

The Packard Electric Co., Limited, of St. Catharines, and R. E. T. Pringle, of Montreal, had their headquarters in parlour K at the new Royal Hotel, where they entertained their friends, as has been their custom in the past. They exhibited a full line of C. P. supplies, including the ordinary porcelain supplies and slate base switches, artistically arranged upon a board, the background of which was black and white. In addition to this they exhibited the new Diamond meter, which is claimed to be correct on inductive load, and a full line of the D. & W. enclosed non-arcing fuses and cut-outs. The exhibit of the latter was the same as that on exhibition in Madison Square Garden, New York, during the Electrical Exhibition in May last.

RECORD OF ACETYLENE GAS PLANTS INSTALLED THROUGHOUT CANADA.

(TABULATED FROM REPORTS SUBMITTED TO THE CANADIAN ELECTRICAL ASSOCIATION.)

Town	Generators. Number installed.	Number discontinued.	Number in use.	Period of Use.	Capacity in Lights.	Number of Accidents.	Advantages.	Disadvantages.	Remarks.
Arthur, Ont.	3	3	0	2 years.	20-16 c. p.	1 explosion.	They have light when required.	Much trouble with Acetylene Gas.	Explosion occurred by gas leaking.
Annapolis, N.S.	1		1		20 lights.				Does not give satisfaction.
Aurora, Ont.	1	0	1	2 years.	40-16 c. p.	No accidents.	Cheapness.	Bad odor. Extra labor in looking after.	Formerly had Electric Light. Imagined Acetylene Gas cheaper. By strict economy costs 75% of Electric Lighting. If used as freely as Electric Light would cost more.
Avonmore, Ont.	1	0	1			Explosion.			Man's hands and face burned. Boy left generator open, caused explosion.
Almonte, Ont.	1	0	1	6 months.	30.	None.	Cheapness claimed, but not as cheap as expected.	People afraid of them, there being so many accidents.	Only a short time established.
Arkona, Ont.	3	0	3	2 years.		One explosion; man badly burned.			These Plants are used here because no other light obtainable except coal oil.
Berlin, Ont.	5	1	4	4 years.	8 to 10 lights	None in Berlin	Better light is claimed.	Strong smell. Danger in handling. Labor and inconvenience in manufacturing.	College authorities gave this matter a thorough test. After using it for a few weeks they threw out the entire Plant, and now use Gas and Electric Lighting for their buildings.
Blenheim, Ont.	4	0	4	Some 1 year; some 2 mo.	15 lights ea.	1 explosion by lighting match where gas had escaped.	Cheaper than electric light.	Think after being in use for some time valves will stick and clog, and probably cause explosions from high pressure. May explode any time from gas escaping when a light is near them.	One man nearly lost his eyesight when the explosion occurred.
Blythe, Ont.	3	1	2	Less than a year.	3 to 6 lights.	None.	Claimed costs half-cost elec. light.	Gives considerable trouble. Costs ⅓ more than electricity and is of short duration owing to cost.	Has been a benefit to Electric Light Plant.
Bridgewater, N.S.	1	0	1	6 months.	12 lights.			Owner would prefer electricity.	Plant is situated about 9 miles from Bridgewater, hence reason for using Acetylene Plant.
Brantford, Ont.	1	1	0	5 months.	20 jets.			Poor light. Machine did not work right.	
Brampton, Ont.	3	1	2	6 months.	10, 20, & 75 lights.	None yet.	Claimed to be cheaper, but not so.	No advantage. Incandescent lamp is far superior. Cost too much and are dangerous.	The people who have the machines are not satisfied with them. Two out of the three generators will not work.
Brandon, Man.	4	4	0	1 year.	20 lights ea.	None.	None.	Dirty, unreliable, costly, etc. (Not sufficient brains to run the machine.) (First-class elec. light system.)	
Brigham, P.Q.	1	0	1	1 year.	5 to 20 lts.				
Carleton Place, Ont.	7	1	6	From 2 mths to 1 year.	20 to 75 lts each; total 350 lights.	None.	Cheaper light.	Very bad odor. Risk of explosion, etc.	Have been told that some who have Acetylene Plants here have since admitted that it is no cheaper than Electric Light. (One of these Plants in Ashton, seven miles from Carleton Place.)
Chatham, N.B.	3	0	3	About 4 mths	30 to 40 lts.	None.	Cheaper than elec. light, for which charge is made 10c per 1000.	Two of the parties also kept Electric Light and have to use it so often that their bill is about the same monthly. Late in evening light gets dim and then they have to turn on Elec. Light.	What is installed in Chatham is no advertisement for Acetylene Gas.
Charlottetown, P.E.I.	2	0	2		10 & 20 lt.	None.	No advantage.	Carbide too expensive.	
Clinton, Ont.	3 and 2 more to be instl'd.	0	3	About 1 year	1-75 lt. 2-40 lt.		Cheapness and good light at any and all times.	One owner of a gas plant informs that it is not as cheap as he was led to believe.	
Coaticook, P.Q.	1	0	1	6 to 8 mos.	20 lts.	None.			
Colborne, Ont.	0	0	0				Cheapness.	Great danger of explosions and damage to property, high insurance rates, etc.	Agents trying to establish Plants here so far unsuccessful. So many explosions in Ontario, people in Colborne are afraid of it.
Cowansville, P.Q.	1	0	1	1 year.	5 to 20 lts.	One.	That it is cheap as coal oil & cheaper than electricity.	Satisfied that it is not as cheap as electricity.	Man got his hand nearly blown off.
Dunham, Que.	1	0	1	1 year.	5 to 20 lts.				
Dundas, Ont.	4	1	3	1 year.		One exploded while being recharged.			Machines are manufactured here.
Dunnville, Ont.	0	0	0						Party had one on exhibition for some weeks; unable to sell even one Plant. Natural gas here as competitor with Elec. Light, used through Auer burners.

TOWN.	Generators. Number installed.	Number discontinued.	Number in use.	PERIOD OF USE.	CAPACITY IN LIGHTS.	NUMBER OF ACCIDENTS.	ADVANTAGES.	DISADVANTAGES.	REMARKS.
Edmonton, Alta.	3	0	3	1 year	30, 30, & 20 lights.		Cheapness & good light.	At times shortage of carbide, and being so far away has caused loss of light for short period.	
Exeter, Ont.	1	0	1	2 years.	20 lts.	Slight explosion.	Cheapness & white light; pay for what used only.	Odor, danger, dust deposit, ghastly light. Attendance, first cost, trouble installing.	
Fenelon Falls, Ont.	2	1	1	9 & 6 mos.	15 or 20 lts.	None.	Can't establish any claims in favor of acetylene gas.	More expensive, troublesome and dangerous.	One party returned machine after 3 mos. use. Wanted Electric Light at price of coal oil, so tried Acetylene for spite.
Florence, Ont.	1	0	1	6 to 8 mos.	50 lts.			Too expensive.	
Frelighsburg, P.Q.	1	0	1	1 year.	5 to 20 lts.				
Galt, Ont.	2	1	1	6 months and 1 year.	10 or 12 lts each.	None.	To get even with the monopolists, the gas and elec. companies.	Users do not say.	1 small Plant is being put in a tavern, which will make 3 installed.
Gananoque, Ont.	3	1	2	1 year.		One explosion caused by looking for leak in generator with lighted candle; man badly burned.	Light on dark days when no current is generated in day.	Cost, bad odor, danger of explosions, time and trouble looking after generator.	One party has come back to electricity. One party uses electricity in his workshop.
Glencoe, Ont.	3	0	3	5 months.		None, although one is said to have had a narrow escape.	That they would be cheaper.	Numerous; when doors of store are opened, the lights are blown out as many as 8 and 10 times in one night when high winds prevail; disagreeable odor from gas escaping.	One of the parties asked my electrician what we would take and put in Electric Lights. They were frozen up for a week during the cold weather.
Georgetown, Ont.	1	0	1	Over a year.	16 lts.	None.	Cheaper than electricity.	Bad odor and dangerous.	
Grand Valley, Ont.	3	0	3	2 years.	20-16 c. p.		They have the light when they require it.	Much trouble with it.	
Grimsby, Ont.	2	0	2	7 or 8 mos.	40 to 50 lts. each.	Explosion in church; burned parson's face.			Don't think they'll last.
Hatley, P.Q.	1	0	1	6 or 8 mos.	20 lts.	None.	Cheapness of light, only means excepting kerosene oil.	No cheaper than Electric Light, dangerous, more trouble and care, and not as sure.	
Holstein, Ont.	1	0	1			Explosion; burned face of young man.			
Ingersoll, Ont.	2	2	0			None.	Nothing said as to advantages.	Bad odor. No cheaper than gas or Electric Light.	Some other contracts taken but not erected. Agents guaranteed too much, probably.
Kentville, N.S.	1	0	1	1 year.	10 lts.	None up to date.	Claimed cheaper than elec. light.	Think parties would not have it installed again.	Firm very jubilant at first, but owing to expense of carbide and danger of explosion, do not say much about it. Electric Company been asked to wire Post Office building to be built this summer.
Louisburg, C.B.	1	0	1	3 mos.			Prefer it to coal oil; no chance to electricity.		Parties talking of putting it in on account of its being cheaper than Electricity.
Lachute Town.	1	0	1	1 year.	40 lts.	One; plumber repairing leak; gas came in contact with fire, causing explosion.	Cheapness of cost of lighting.	Danger of life and property from explosions which may occur at any time.	The party who has this Plant installed narrowly escaped with his life; badly burned about the face. Think Plant will be discontinued.
Lakefield, Ont.	2	1	1	8 mos.	40 lts.	None.		More explosive than electricity.	
Lindsay, Ont.	6	3	3	6 or 8 mos.		None.	Sore heads.	Trouble, expense and risk.	One party who discontinued Acetylene Gas has installed Electric Light; other two who discontinued always had Inc. Lts. User is agent for Acetylene Gas; other users have grievances against Elec. Co.
Listowel, Ont.	2	2	0	4 & 12 mos.		Reported explosion, but denied.	At first better light and cheaper.	Now not so cheap. An everlasting bother and unsafe.	
Londesboro, Ont.	1	0	1		16 lts.			Give considerable trouble.	No Electric Plant here. Gas has been a benefit to Electricity.

TOWN.	Generators, Number installed.	Number discontinued.	Number in use.	PERIOD OF USE.	CAPACITY IN LIGHTS.	NUMBER OF ACCIDENTS.	ADVANTAGES.	DISADVANTAGES.	REMARKS
Millbronk, Ont.	2	0	2	six mos.		One explosion doing much damage.			Explosion caused while charging machine while in operation.
Madoc, Ont.	2	0	2	3 mos.	20 & 60 lts.	One.	Hotel can have lt. all night. Elec. Plant only runs till 12 p.m.	Higher cost than Electric Light, dangerous, disagreeable odor. Costs more.	Parties regret putting in Acetylene
Morden, Man.	10	4	6	12 mos.	From 20 to 100 lts ea.	One explosion; man's face scorched, also head.		Offensive odor; sooty deposit; nuisance of having to clean out and charge at regular periods. Costs twice amount of Elec. Lt. without counting man's time. Irregular supply of carbide.	
Napanee, Ont.	1	1	0			Exploded first time used; never tried again.		The fact of an explosion which shook a large 3-storey stone building is enough.	
Norwood, Ont.	1	0	1	2 mos.	20 lts.		Claimed cheaper.	Labor in connection with it.	
Orangeville, Ont.	2	1	1	8 mos.			Cheapness.	Danger from explosion.	
Owen Sound, Ont.	0	0	0						One party bought Acetylene Plant, but after enquiry purchaser refused to take it. People here have no use for Acetylene Gas.
Oxford Elec. Lt. Co.	1	0	1	4 mos.	50 lts.	None.	Cheapness and efficiency.		
Parkhill, Ont.	3	0	3	1 year.	100 lts ea.	One; nearly blinded man.	Don't know that any are claimed now.	Trouble keeping pipes clean and generator in good working order.	
Parry Sound, Ont.	1	0	1	2½ mos.	30 lts.	None.	Cheapness.	Unpleasant odor; comparative inconvenience and more or less danger. Light also, although strong, is unpleasantly glary.	
Pembroke, Ont.	0	0	0						People will not use it here on account of reported accidents.
Perth, Ont.	3	0	3	4, 6, & 12 mos.	20, 20, & 60 lights.	None.	Cheap; good light; local control.	Danger of explosion. Disagreeable odor throughout premises; trouble in lighting.	
Prince Albert, N.W.T.	2	2	0		50 & 7 lts.	None.	Less cost.	Dangerous; unclean; destroy goods by smoke. Supplies cannot be obtained when wanted.	
Port Hope, Ont.	1	0	1	9 mos.	10 lts.	None.	Say it is cheap.	No cheaper than Electric Light here, while it is a dangerous explosive and very offensive.	
Rat Portage, Ont.	4	2	2	18 mos.	10, 20 & 40 light.	Escaping gas caused explosion.	Not any; would stop if money were not invested	Trouble of frost in winter. Burners blocking with carbon and fluctuating.	Explosion blew out front of building, which put effectual stop to installations of Gas Plants.
Regina, N.W.T.	2	1	1	6 mos.	60 to 80 lts. each.	None.	Cheap light.	Have to protect generators from frost; generator located in cellar where furnace is. Ins. Co. will not allow this. Burners clog up; require too much attention. Foul smell, which in one case ruined stock of groceries. Plant thrown out.	Electric Light substituted and vendor of plant compelled to stand damages. Adjusted by arbitration.
Sackville, N.B.	1	0	1	6 mos.	25 lts.	None.	Cheapness.	Bad oder, and also that water in gasometer freezes in bad weather.	
St. Mary's, Ont.	7	1	6	1 to 2 years;	10 to 20 lts.	None, but looking for them daily.	Economy, able to light when desired.	Danger, smell, soot, smoke, apt to freeze up, as they nearly all did here last winter.	Claims for economy thought to be false. If Electricity were used as carefully as Gas the economy cry must stop.
Sarnia, Ont.	2	1	1	Few mos.		None.	A refuge when one quarrels with the local company.		
Seaforth, Ont.	4	2	2	6 mos and 1 year.	16 & 20 lt.	None.	Cheaper than elec. light.	Hard on eyes when reading. Amt. of attention and expensive.	Only way to make it cheap is not to burn it. Parties who have discontinued use of gas now use elec. light.
Shelburne, Ont.	1	0	1	5 mos.	10 or 12 jets.	None so far.		Trouble in charging and disagreeable odor.	Not overly satisfied with the gas.
Smith's Falls, Ont.	5	0	5	18 mos.		One or two explosions	Cheapness.	Cost of attention and danger from explosion.	Acetylene people are trying to introduce and push their business, apprehensive that they will injure electric lighting very materially.
Stayner, Ont.	0	0	0						Reports of accidents knocked prospects of Acetylene Gas out.
Strathroy, Ont.	1	0	1	1½ years.	15 or 20.		Have heard of none	Lights not burning sometimes; do not know cause; trouble, inconvenient, bad odor. Some person has to take charge of it.	About 1½ years ago Plant was started for exhibition. Something went wrong with generator, which was taken outdoors, where it exploded.

Town	Generators. Number installed.	Number discontinued.	Number in use.	Period of Use.	Capacity in Lights.	Number of Accidents.	Advantages.	Disadvantages.	Remarks.
Stratford, Ont.	4	4	0						
Stouffville, Ont.	4	2	2	About 2 yrs.		One.		Need much attention; accumulate a kind of coal on the jet, causing them to smoke; very dirty.	
Sussex, N.B.	1	0	1				Cheapness & good for matching colors.	Smoke from burners, which tarnishes; responsibity of looking after; bad odor.	
Sutton, P.Q.	6	0	6	About 1 year.	5 to 20 lts.				
St. Thomas, Ont.	7	4	3	8 mos.		One; attributed to tinkering with hot soldering iron.		Unsafety; unpleasant odor; dirties rooms where used; expense of maintenance.	
Sault Ste. Marie, Ont.	12	0	12		5 to 50 lts ea. total 330 lts; 146 lts. in operat'n.	3; caused by using lighted lamps near generators.	Cheapness.	Strong smell of gas; trouble washing out tanks, cleaning burners; offensive smell; danger having goods near jet. Dry goods merchants cannot dress their windows as is possible with electricity.	Consumers of Acetylene Gas not satisfied.
Thamesville, Ont.	1	0	1	6 or 8 mos.	50 lts.				Uses it just in morning. Uses Electricity.
Tilsonburg, Ont.	6	4	2	11 mos.	10 to 20 lts.	None very serious.	None; sorry they got them.	Too expensive, bad smell and dangerous.	
Whitechurch, Ont.	1	0	1					Complete failure.	Cannot learn cause of trouble. No Electric Plant.
Walkerton, Ont.	4	2	2	1½ years.	30 and 7 lts.		Cheapness, as they do not have to pay for lights not in use.	Dirt, smell, danger and trouble. Do not use it at one place unless the man is at home.	One Gas consumer (discontinued now.) Uses Electric Light.
Wallaceburg, Ont.	2	1	1	8 mos.	50 and 75.	None.	Superior light and cheap.	After burning a number of hours, if not carefully watched, ruins everything in room by emission of fine particles of soot or carbon. Does not admit of fancy window dressing. On account of thinness of gas it leaks through a very small hole, and in consequence smells most offensive.	
Winona, Ont.	1	1	0	2 or 3 mos.	30 or 40 lts.	None.	Claimed to be cheaper.	Much more expensive, not as good a light and very dangerous.	
Waterloo, Ont.	4	2	2	2 years.		Two; not very serious	Cannot say.	Dangerous; dirty; black dust which forms on burners, soiling carpets, etc.	One party tried it, soon had an explosion and threw it out.
Windsor, Ont.	0	0	0						Tried for a time for advertising purposes, then taken out.
Woodstock, Ont.	1	0	1	3 mos.	50 lts.	None.	Cheaper, and can run all night; elec light runs only till 12 p.m.	Go out occasionally. Leave dust and liable to explosion. Freeze up.	
Wiarton, Ont.	1	0	1		12 jets.		Good light.		
Wingham, Ont.	1	0	1	1½ years.	17 lts.	One explosion; no damage.		Cannot depend upon it at all times. Disagreeable and expensive.	Owner of the Gas Plant uses Arc lamp sometimes, and had 27 Incandescent lamps put in in Jan. last.
Woodstock, Ont.	5	3	2	2 or 3 mos.		Explosions, but no damage.	Less cost.	Much bother in attendance; unsafe; offensive odor.	
Vancouver, B.C.	sever'l	all n'ly	0	Within a yr.			After being in use a time—none.		Nearly all parties who used Acetylene are using Gas or Elec. Light again. Competition not felt.
Zurich, Ont.	1	0	1			One; blew side and end out of a store; damage over $1000.			
Halifax, N.S.	3	0	3	Eight mos.	2-50 lt. 1-10. 3-10 light.		One man pertinently remarked that the only advantage of using this gas is, that no difficulty is experienced in locating a leak in the pipe.	Obnoxious odors emanating from the apparatus. Disagreeable nature of the refuse material. Difficulty in keeping apparatus clean. Continual clogging of jets. Danger of explosion and extreme care necessary in handling and keeping the raw carbide. Decided nuisance. Dazzling nature of light from gas also objectionable.	Two plants operating successfully. The system has not proved a great success in the vicinity of Halifax, at least.
Dartmouth, N.S.	2	0	2						

SUMMARY: Total generators installed, 217; number discontinued, 62; number in use, 155; number of accidents, 30.
NOTE.—Data probably inaccurate as to number of generators, discontinued, in use, capacity of lights, period of use, etc.

RESULTS OF THE USE OF ACETYLENE GAS

AS GIVEN IN ABSTRACTS OF REPORTS FROM CANADIAN NEWSPAPERS.

The Erin & Brennan Company appeared in the City Hall, Guelph, last night. An acetylene gas generator exploded during the proceedings, caused by one of the performers passing the generator with a lighted candle, which ignited the escaping gas. Explosion after explosion followed, and some of the scenery took fire. The caretaker had his hands badly burned, and the stage carpet and scenery were scorched. Brockville Recorder, March 28, 1898.

An acetylene gas generator exploded in a house in Oshawa recently. The machine was blown to pieces, a portion of it making a hole through the ceiling. Quebec Telegraph, April 23, 1898.

The blowing up of an acetylene generator in the rear of Fuller's cigar store yesterday caused much excitement in the neighborhood. The upper part of the machine was blown upwards, the pipes and valves twisted, the galvanized tinwork dinted, and the west wall of the room singed. There was very little gas in the generator, otherwise the results would have been more serious. The origin of the fire was peculiar. Over the back door of the room where the generator was placed there was an overflow pipe extending out from the building. A match being thrown down ignited the overflow gas, the flame travelling along the tube to the generator and igniting with the larger supply of gas there.—Woodstock Sentinel-Review, April 5, 1898.

Our reporter has just had an interview with Mr. Brick regarding his experience in lighting the Vendome Hotel. Mr. Brick contracted for a 75 light acetylene gas plant. The generator was outside in a separate frost-proof building, partly to meet insurance requirements aad partly to obviate the objectionable stench in cleaning it out daily. After a trial of over three months Mr. Brick has discarded the acetylene gas plant, and has had the entire hotel fitted up with 66 incandescent electric lights from the town plant. He claims that electricity is not only cheaper than the gas, but the objection to the acetylene is its offensive smell and its getting out of order.—Teeswater News, January 4, 1898.

Acetylene in the liquid form is extremely dangerous, but that used in bicycle lamps is not much more harmful than the same amount of kerosene.—Hamilton Spectator, June 3, 1898.

By the explosion of an acetylene generator, Mr. E. H. Morse, dry goods merchant, of Blenheim, Ont., received injuries that may possibly prove fatal. The generator had been leaking for some time, and Mr. Morris went to the cellar to make an examination. Lighting a match, he was examining the joints for a leakage, when the gas exploded with great force, burning his face terribly.—Brockville Recorder, October 8, 1898.

A serious acetylence gas explosion occurred at Cobden, Ont., yesterday evening, as a result of which Mr. A. G. Best had his face and right hand severely burned, and it is possible that his eyes may be injured. Mr. Best was engaged in installing his first plant in Arne's jewelry store, when the explosion occurred. It was caused by Mr. Best opening the carbide chamber and holding a lighted candle over it.—Ottawa Free Press, November 3, 1898.

Alfred Head, of Calgary, N.W.T., was fatally injured as the result of an explosion of acetylene gas, which occurred while he was endeavoring to locate a leak with a match.—Guelph Herald, December 17, 1898.

A serious explosion of acetylene gas took place in W. Nixon's hotel, Avonmore, on Friday last. The carbide chamber of his acetylene gas machine had not been properly closed, and a leakage of gas took place. Before Mr. Nixon could extinguish the light, the escaping gas reached the flame and a terrific explosion followed. Mr. Nixon was terribly burned, and his wife and an employee were slightly injured. The building was also damaged, nine windows being blown out.—Winchester Press, March 30, 1899.

An acetylene gas machine, located in Merner Bros' general store at Zunich, Ont., exploded yesterday, completely demolishing the building. The force was so great as to blow out the east side and front of the building, also wrecking several buildings on the opposite side of the street. The loss on stock is estimated at $1,000. Guelph Advocate, March 16, 1899.

The acetylene gas apparatus at the Marbleton hotel exploded on Friday, setting fire to the hotel and destroying apparatus. Several persons were badly burned. Stanstead, Que., Journal.

The new acetylene gas machine lately put in by Mr. W. H. Todd is not giving the satisfaction anticipated.—Stouffville Sentinel, February 3, 1899.

Acetylene gas caused a violent explosion in the Barker House, Fredericton, N.B., a short time ago. The generator was being moved from one part of the building to another, and after the pipes were disconnected and the generator removed, a lighted lantern was taken into the room where it had been, when the escaped gas exploded. The building was badly shaken up and the plate glass windows blown into the street.—Canadian Engineer, February, 1899.

The acetylene gas machine on the premises of the A B. Scott Co., general merchants, exploded yesterday afternoon. The plate glass windows were almost totally wrecked and other damage done. Mr. Scott was slightly burned, and Miss Walls was struck on the head by flying debris.—Toronto Mail, January 6, 1899.

UNDERWRITERS REGULATIONS AS TO THE USE OF ACETYLENE GAS.

The United States National Board of Fire Underwriters have approved of a set of rules for governing the acetylene gas hazard, because of the attempts to introduce acetylene gas as an illuminant in various parts of the country. These requirements provide that the generating and gas holding apparatus, when installed for lighting buildings in the closely built up portions of towns and cities, must be situated in an outside, fireproof and well ventilated building; that bicycle and other portable lamps in which gas is generated and supplied direct to burner should not be approved until such lamps are so constructed that they will cease to generate gas immediately upon the extinguishment of the flame; that the storage of liquid acetylene in any building, or the use of liquid acetylene gas, should be absolutely prohibited; that in regard to the separator and gas holder, it is recommended that only wrought iron or steel, capable of resisting an internal pressure of twenty pounds to the square inch, should be used.

TRANSFORMER ECONOMY.

By F. H. LEONARD, JR., Montreal.

The practical use of A. C. Transformers covers a period of little more than a decade, and yet in so short a period they have been developed into the most perfect piece of apparatus known to the art of electrical engineering. Transformers having a full load efficiency of 98% in the large sizes are not unusual, and in the very large sizes even this high figure is exceeded, and with the best designs the no load losses are less than one-half the full load loss, permitting an exceedingly high efficiency to be maintained over the entire working range.

While the commercial application of transformers is so recent, the principle was demonstrated more than 67 years ago by Faraday, whose investigations gave to the electrical engineer the principles on which are based the science of dynamo-electricity. Faraday in 1812 made a crude transformer, which is identical in general principle and construction with the commercial article of to-day. There are many types and modifications of details, but the commercial transformer of to-day may be simmered down to two general types, known as the shell type and the core type; the once much talked of hedge-hog transformer so stoutly championed by Swinburne having dropped out of the race entirely. There are still strong adherents to both of the first mentioned types. The adherents to the core type of transformer will tell you that the coils are more easily wound and the core itself more easily insulated, that the copper coils being on the outside radiates the heat due to internal losses more quickly. Notwithstanding these seeming advantages to the casual observer, the Johnston & Phillips Co., Ltd., of London, England, who first manufactured this type of transformer from the designs of Gilbert Kapp, after extensive experience with them, abandoned their manufacture aud became adherents to the shell type.

For an equal investment in material and labor it has been demonstrated that with proper design a better transformer can be built of the shell type than of the core type. The double magnetic circuit of the shell type gives a shorter average path for the lines of force, which, combined with a smaller number of breaks or interruptions in the magnetic circuit, call for a less number of ampere turns or magnetizing force, and result in giving the shell type the advantage of a better power factor at light load.

With proper machinery the coil for the shell type transformer can be wound and carefully insulated with but little more trouble than the core type, and the waste in copper in turning the ends of the coil will be no greater than is necessary in the cylindrical coil used with the core type, which touches only at the four corners of the core, which for commercial reasons is made of a rectangular cross section, leaving considerable space inside the coil not filled with iron.

There are many points of view from which comparisons can be made, too numerous for the limits of such a superficial treatise as this, which, generally speaking, favor the use of the shell type, which we believe will be the standard as improvements are made and the results of careful tests are more thoroughly understood.

The sub-division of coils in a tranformer is one of the most important features both as regards the safety of its insulation, owing to the corresponding reduction of potentials between adjacent points, and also as regards regulation. With proper sandwiching and subdivision of coils in both primary and secondary, the drop due to magnetic leakage may be reduced to a negligable quantity, so the drop in voltage as the transformer loads up may be practically confined to what is due to the ohmic resistance in the copper. This is essential, as the regulation of transformers plays a most important part in the quality of service to customers. Good regulation means from 2% in the small sizes to one per cent. in the larger sizes. No one has yet discovered a satisfactory method of compounding transformers so as to maintain the voltage as high at full load as at light load, and as line drop in the primaries as well as in the secondary and inside wiring tend to aggravate and magnify this condition, the importance of guarding against everything tending to drop the voltage will be appreciated, particularly when it is more clearly understood that a variation of one per cent. in voltage will make a difference of about 5% in the candle power of lamps.

Too much importance cannot be attached to hysteresis or the core loss of transformers, which calls upon the generators for a continuous supply of energy to overcome this loss as long as the transformer is in circuit, regardless of the conditions of load being the same when no current is drawn from the seconday as when fully loaded, and if the power factor of transformers is low the apparent flow of current on this score is greater at no load than at full load. Good transformers should, in the small sizes, not require more than 2% of the full load energy to cover this loss, and large transformers less than 1%.

While the copper loss of a transformer remains constant for any fixed load, throughout its life the core loss—if proper precautions are not taken in the selection of iron and provisions made in the design to maintain it at a low temperature—may increase considerably, often doubling this source of loss in a very short period, and accordingly reducing the all day efficiency, and this increased loss has to be supplied from the central station, for which it receives no income.

From the foregoing hints it will be seen that well designed, modern transformers should give a full load efficiency, depending upon their size, of from 95 to 98% or better, which with good design and proper selection of materials will maintain this efficiency unimpaired.

It is only recently, however, that such transformers could be obtained, and the matter of ageing of the core plates has but recently received attention. It is not more than three years ago that one of the largest electrical manufacturing companies in the United States sold to a large central station, under guarantee of certain efficiencies for the various sizes of transformers covered by the contract, and were obliged to take back every transformer before they had been in service four months, on account of the rapid increase in the core loss, which in many cases, in the short space of time mentioned, had doubled the losses shown in the original factory tests. The iron was taken off the coils and a different quality of iron substituted, which, though not giving quite such good initial results, was able to maintain its efficiency unimpaired, exhibiting no apparent ageing after repeated tests extending over a period of eight or nine months.

By careful experiments with various samples of iron of known chemical composition we have been able to determine which is the best for use in transformer cores, and samples of every lot of iron are submitted for tests for hysteresis loss and for chemical composition. Without such precaution no assurance of results of transformers in service can be secured. Even with the best of iron ageing will take place to a slight extent unless precaution is taken to operate the iron at low inductions, and provide sufficient radiating surface to prevent the transformer becoming too much heated, it having been observed that iron will age much more rapidly when subjected to high temperatures.

As the energy losses in transformers exhibit themselves in heat precaution should be taken to get efficient transformers which operate at a low temperature, obviating the tendency to charge the insulation, at the same time saving the dynamo capacity necessary to overcome these losses and avoiding the ageing of the iron and subsequent augmentation of losses.

Oil may be used in small transformers, and where the losses are large the oil helps materially in radiating the heat. The life of a low efficiency transformer may be considerably increased by filling the case with oil, but this is unnecessary in small transformers of good design. In large transformers of 100 k.w. or more it becomes necessary to use some method of dissipating the heat, as the proportion of radiating surface rapidly decreases as the transformer increases in size, and oil or an air blast becomes necessary even in transformers of over 98% efficiency. We have designed and built 60 cycle transformers of 60 k.w. capacity having a full load efficiency of 98%, which, with only the natural air circulation, have shown a rise of temperature, after 10 hours continuous run at full load, of less than 50 C. This same transformer operated at 125 cycles will run at a higher efficiency with a smaller rise in temperature. Such transformers are rather expensive, however, and where slightly lower efficiency will suffice, an oil transformer can be used at a much lower cost of construction which will give no greater rise of temperature.

Lightning discharges are less dreaded now by central station managers than they used to be. Formerly every thunderstorm brought with it wreck to some of the transformers on the line; this has, however, come to be the exception rather than the rule owing to the substitution of modern transformers, in which the better insulation, together with the greater choaking effect, which follows with higher efficiency and reduced core loss, results in forcing the oscillatory high frequency lightning discharges to take some easier path to equilibrium of potentials. Notwithstanding this, do not neglect to install lightning arrestors, for though the improved transformers offer a more difficult path, yet if there are no lightning arrestors through which these potentials can discharge, the best transformers are liable to be punctured. The suggestion has been made to ground the secondaries or the case of the transformers. Either method makes it safer for the consumer, but both result in greater strain on the insulation of the transformer.

We have had frequent inquiries as to whether the 60 cycle transformers will work on 125 or 133 cycles. A transformer suitable for 60 cycles or 7200 alterations will work better on 125 cycles or 15000 alternations than on the 60 cycles, as the core loss is reduced, though the regulation due to increased magnetic leakage is not quite so good. It is quite the opposite when a 125 cycle transformer is used on the 60 cycle circuit, as in this case the core loss is increased about 30%, and the efficiency correspondingly decreased. If the transformer is not a very superior one, at 125 cycles it is quite likely to overheat, due to the increased core loss at 60 cycles, gradually charring the insulation until it finally breaks down, in the meantime probably showing an increasing core loss followed by further development of heat and bringing about the end at an earlier day.

As the difference between two lots of iron from the same manufacturers may make a difference of ten or twenty per cent. in the core losses of transformers, otherwise identical, it is of the utmost importance for manufacturers to make careful tests of each shipment of iron as it is received, and when this is not done the central station has no protection unless they possess the instruments to make proper tests on the transformers themselves as they are received.

For their own protection we would urge central station managers to equip themselves with standard wattmeter, dynamometer and voltmeter, with which it is a simple matter to determine whether they are getting what they pay for or not.

The tests are quite simple and any central station can equip for making them at very small expense, amounting to but little outside of the cost of the necessary instruments, which are almost a necessity for any central station in checking up switchboard instruments, recording meters, &c.

Central station practice has not yet settled down to uniform methods of installation, but the trend now seems to be in the direction of larger transformers with secondary networks, preferably on the thin wire system; the general introduction of meter basis of charge making it possible to safely connect double the rated transformer capacity in lamps to the secondary network—whereas with the older systems providing a separate transformer for each connection it was necessary to provide transformer capacity equal to the lamps connected.

With separate trasformers of small sizes necessary for individual supply, the aggregate core losses become a serious drain upon the central station. We have frequently seen banks of small transformers serving a single customer or group of customers, this condition being brought about by the gradual growth of demand for light exceeding the capacity of the original transformer installed, a further growth exceeding the capacity of the second, and so on. In such cases the substitution of a single large transformer of modern design displacing the small ones would save its price in less than a year, if credited at the usual selling price, with the amount of current saved. Don't put a modern transformer of good regulation into a group of antiquated transformers of poor regulation; if you do you will lose your new transformer, which is likely to be unjustly condemned for trying to improve the regulation of its bad associates. Placed in such company the new transformer tries to maintain the good regulation for which it was designed, while the lazy, old shirks with which it is connected, steeped in the vice of bad regulation, throw their entire load onto the new comer, which good naturedly carries it all till it can no longer stand the strain and literally roasts out and breaks down under the load.

In most of the smaller stations and in many of the larger ones, money can be saved by remodelling the system of distribution, and at the same time improving the service by laying out a net work of secondary mains, starting first in the business portion of the town with the installation of a few large transformers, reserving the small transformers which these replace—if they are modern and worth keeping—for extensions in the more remote sections where for the time the secondary network is impractical. It may occur in some cases the secondary network will be practical in several different sections, and these separate sections will, in most cases, gradually grow together, allowing taps to be made for new customers at intermediate points. In most cases, where prices are based on meter rates, such an arrangement can be installed at no greater first cost than the individual transformer system, the saving in cost of transformers on account of their larger size and less total capacity required paying for the copper mains. Such an arrangement always results in more satisfactory service to the consumers, at the same time greatly reducing the leakage current necessary to magnetize the transformers or supply the waste in core losses.

A few figures may serve to impress the idea more firmly in your minds. Let us take the case of a station having an average load equivalent to 1000 lights, most of which average four hours burning per night, and, making due allowance for belting, dynamo, line, transformer and secondary wiring losses, we will allow that 10 lights are obtained per 1 h. p. at full load. In the first case we will suppose an individual transformer system is installed, using 10-10 light, 10-20 light, 10-30 light, 5-40 light, and 4-50 light transformers; even with modern transformers these would have an aggregate core loss of about 1200 watts.

If we substitute for this arrangement 6-150 light transformers, connected with secondary mains, retaining the 10 small transformers for isolated customers so scattered as to make it impractical to connect them to the secondary mains, our core losses will be reduced to 692 watts, or a saving of 448 watts for every hour the plant is run, which, for twenty-four hours a day, would amount to 3920 k. w. hours per year, which at 10c. per kilowatt hour would be $392.00, or 6% on more than $6500.00, a sufficient amount to more than pay for the change if no consideration is made of the transformers left on hand, which would be superseded by the new arrangement.

In the case just mentioned we have assumed the original arrangement to be modern transformers. Had we assumed them to be old types the saving would have been three or four times that shown, and would have allowed us to make a good or a better showing had we only charged 3c. per kilowatt hour, which would be less than the cost of production in a station of 1000 lights capacity.

Some of our friends may argue that these losses cost them nothing, as they are running on water power, but we would like to remind them that the capacity in their generators, water wheels, or whatever prime movers they use, represent capital invested, which add to the fixed charges their pro rata of interest and depreciation for which it makes no return; whereas, if the capacity used in overcoming these losses could be rented at the usual rates, a material difference in the capacity to pay dividends would be shown.

METERS AND METER RATES.

By A. A. Dion, Ottawa.

There are few things of more importance to owners of electric light plants, or having a more potent influence for the financial success or failure of electric supply undertakings generally, than meters and meter rates; and all those interested in the satisfactory solution of the problem "how to increase profits from electric supply" should give the subject of this paper thorough and serious consideration.

In these days of close competition in lighting, in common with all other industries, where we feel the need of constant study and investigation in order to find, if possible, means of reducing the cost of production, should we not devote ourselves with equal energy and perseverance to the task of increasing the earning power of our plants?

Upon this question, meter rates have a direct and important bearing.

METERS.

It seems hardly necessary at this time to make a plea for the use of electric meters. Experience has established, beyond question, the fact that the use of meters increases the earning power of a plant. A change from flat to meter rates invariably lowers the peak of the station load curve to such an extent, that the lamp installation may be doubled before the peak regains its previous value; the average earnings per lamp installed will be such as to show an increase in the total revenue, unless indeed the flat rates previously charged were so high as to confine the use of the lights to long-hour consumers.

The use of meters also places the owner of a plant in a position to compete successfully with gas and other illuminants for all classes of consumers, thereby facilitating the extension of his business. This cannot be done under a flat rate system, except by making all sorts of special rates, to meet special cases; a proceeding which is certain to produce dissatisfaction among consumers and often works injustice to the supplier.

No attempt will be made to give in this paper a history of the electric meter; not even to enumerate the many forms that have been produced in the process of evolution, to which we owe the modern recording meter. Too much valuable time would be taken up and no very useful purpose would be served by the recital, as far as this Association is concerned.

Those who feel any interest in the subject may be referred to a paper read by Mr. George W. Walker, before the American Institute of Electrical Engineers, May 21st, 1891. Later meters have been described and illustrated from time to time in the electrical press.

It is necessary to the full success and popularity of the meter system of charging for current, that the meters should be direct reading, in other words that the record of consumption should appear in plain figures on dials available to the consumer, as he has long been accustomed to in gas meters.

The Canadian Electric Light Inspection Act prohibits the use of any but direct reading meters, therefore the choice of meters lies between the different forms of these meters, generally known as "motor meters."

These meters are essentially electro-motors operated by the current to be measured and whose rotating member actuates a train of registering wheels and dials.

They may be divided into two general classes, namely:—

First. Those operating on the inductive principle, wherein an armature consisting of a ring, disk or cylinder of metal, generally iron, is carried around by a rotating magnetic field. This field results from the current to be measured passing through a coil or coils of wire, and the current induced in a closed secondary coil, of low resistance, set at angle with the first; and, second, those embodying the well known principle of the direct-current motor; a wire wound armature rotating within a magnetic field.

Meters of the first class are suitable for alternating currents only, and must be calibrated for the frequency at which they will be operated. They have no commutator nor brushes. Those of the second class may be used for either direct or alternating currents of any frequency. They have a commutator and brushes. That is their weak point, as dirt and moisture will affect the commutator, and the meter will in time run too slow unless it is cleaned occasionally, which is a troublesome proceeding, now that meters are sealed by the Government. They require delicate and careful handling.

Meters of either class may be "current meters" recording in ampere-hours, or "energy meters" which register in watt-hours.

In meters of the first class, which are generally current meters, the torque is approximately proportional to the square of the current, and the speed is proportional to the torque. Such are the "Schallenberger," "Duncan" etc.

In meters of the second class, generally energy meters, such as the "Thomson," the torque is directly proportional to the power applied and the speed is proportional to the torque.

All meter armatures left free to revolve, run so fast at high loads as to seriously impair the accuracy and durability of the meter, and means had to be provided to restrain their speed. This was done in two ways. Small vanes or air fans were attached to the end of arms rigidly fixed to the aramature shaft. These fans lie at right angles to the direction of rotation, and the retardation is due to the resistance of the air against them, which is approximately proportional to the square of the speed, so that this device may only be used in those meters where the torque is proportional to the square of the quantity to be measured. The other way was to attach to the armature shaft a copper disk revolving between the poles of permanent magnets. These exert a drag on the eddy currents generated in the disk by its rotation in the magnetic field. This magnetic drag is proportional to the speed, and is employed in meters where the torque is proportional to the quantity to be measured.

The majority of meters will not start with less than three per cent. of their full loads, and tend to run slow at light and high loads. This is a serious drawback, but there appears to be no effective remedy for it at the present time.

In choosing a meter the first point to be settled is whether to use a "current" meter or "energy" meter. At first sight it would seem that the energy meter would best suit our purpose, as it records the actual expenditure of energy, but where energy is supplied at a constant voltage, the record of the current meter in volt amperes is proportional to the energy. With alternating currents, and especially with inductive loads, the record will be slightly in excess of the energy, but will be porportional to the machine capacity employed, which is a perfectly reasonable charge against the consumer, since it is the maximum load in volt-amperes that determines the size of the plant and the fixed station expenses. The current meter has the advantage of simplicity, ease of adjustment and less cost. It lends itself admirably to the lamp hour-rate of one cent, as its record shows the lamp hours. Rates may be varied to suit all conditions by a system of discounts from the one cent rate.

The desirable characteristics of a meter are: Initial accuracy, constancy, simplicity of mechanism and indicating dials, durability, ability to exclude dirt, insects, etc., and to withstand tampering. Examination and test will determine how far these characteristics are possessed by a meter, except those of constancy and durability, which can only be established by a test of time in regular practice. Both however, depend on good design and workmanship, especially in the jewel bearings which should be of the best quality, accurately ground and thoroughly polished.

The writer has for some years used the "Schallenberger" current meter which has met all the conditions of actual service in quite a satisfactory manner with only ordinary care. He had some experience with a certain type of meter in which so much heat was developed at normal full load as to roast the varnish on the outside of the wire coils. It is needless to say that such a meter should, under no circumstances, be used.

METER DEPARTMENT.

The importance of a well organized meter department and properly equipped meter room, wherein testing, adjusting and repairing of meters may be intelligently carried on, cannot be too strongly urged. This department should be given in charge to one man who may be carefully instructed in his duties and educated to perform his work in an efficient and systematic manner.

When meters are received from the factory they should be examined, tested and adjusted if required before they are sent for government inspection.

Records of these and all meter tests, of meters certified by the government, installed or taken out, and of meters repaired, should be kept in the meter room in a day book for that purpose where entries may be made from day to day, designating such meter by the serial number, size and make. There should also be a ledger into which, day-book entries should be posted. A page to be headed, for each meter in use, by the serial number, size and make. In this way each page will contain a complete history of one particular meter and this will be found very useful for reference.

No meter should be installed, removed or tested without orders from some one in authority. It is a mistake to allow any employee in the office to order meters changed and tested.

METER ROOM.

This room should not be accessible to any employees except those of the meter department.

There should be in a well lighted corner of this room a work bench with such tools and appliances as will be required in repairing and adjusting meters.

A substantial wooden rack should be erected against a solid wall, quite free from vibrations, where the meters may be hung up in rows, by means of hooks or catches, fashioned to hold them firmly in a level position. Flexible wires ready to be inserted in the binding posts of the meters and short-circuiting plug devices, allowing the cutting out of any meter without opening the circuit, should also be provided. The meters should be connected in series and the circuit, which must be of large wire, should pass through a main switch and cut-out, a rheostat to adjust the voltage, a good dead-beat wall ampere meter and a master meter used as a standard in making tests. There should be also, connected across the circuit, a reliable voltmeter, dead-beat if possible, and a bank of incandescent lamps of various candle-powers, say 16, 10 and 5, to adjust the load.

The "master meter" or "standard" should be tested once a month.

The following directions for testing will be found useful. If the master meter is a "current" meter, proceed as follows;

1. Adjust the current to full load of meter.
2. Count the revolutions of the armature by means of the tell-tale index at the top of the shaft or otherwise, for a number of seconds, depending on a constant furnished by the makers for each size of meter. (This constant represents the time taken by the armature for one revolution when a current of one ampere is passing).
3. The revolutions should be counted for a number of seconds equal to several times the constants, in order to secure accuracy, and the revolutions counted during that time, multiplied by the constant of the meter and divided by the number of seconds, should equal the amperes passing through the meter during the test. If the amount is greater, the meter is running fast, if less, the meter is too slow.

4. Repeat the test at half load and quarter load.

The current should be calculated from the indications of a Siemens dynamometer. If none is available, the wall ampere meter, which should be frequently calibrated, may be used instead.

For an "energy meter" proceed as above, adjusting the voltage carefully to normal as well as the current and use a wattmeter instead of the ampere meter. A stop watch is better for this test. If no stop watch is available, two men should make the test, one counting the revolutions, the other holding an ordinary watch. The case should be on the meter during this test to avoid the disturbing influence of air currents, the rotation of the armature being observed through a small window in the top of the case. The voltage should be quite steady.

There may be a separate master meter for every kind and size of meter if desired, but that is hardly necessary.

Meters can be adjusted by altering the angle between the primary and secondary coils in inductive meters, or by shifting the position of the retarding permanent magnets where these are used.

When it is desired to test a number of meters, examine them and see that the armatures are turning freely and the shafts resting properly in the jewel bearings; hang them upon the testing rack, connect them in series, and put the cases on, then

1. Close the circuit, adjust the voltage and turn on one 5 candle-power lamp and see if meters start. (Meters of ten amperes should start on this lamp, those of twenty amperes on one lamp of ten candle power, those of forty amperes on two similar lamps, and those of eighty amperes on two lamps of sixteen candle-power. Meters that fail to start as above should be tagged for repairs.)
2. All the meters on test being of the same size, adjust current to full load and watch the pointers on the last right hand dials; run the meters, including master meter, cutting them in and out of circuit until all the pointers are exactly over a number in the last right hand dial.
3. Open the circuit and take readings of all the meters.
4. Close the circuit, adjust current to half load and allow the meters to run several hours, after which readings may be taken and the "consumption" compared with that recorded by the master meter.

   A meter testing over three per cent. slow or fast should be given a second test to confirm the first.

The advantage of a long run in series with a standard meter is, that it makes it easy to detect and measure very small percentages of error.

When a meter is brought in for any reason it should be tested before it is taken out. When it becomes necessary to test a meter after it has been installed, it is better to bring it to the meter room, putting another one in its place, as no proper test can be made on the consumer's premises. Several methods have been suggested for domiciliary testing, but none are quite satisfactory, besides it pleases a customer better to change his meter when he has lost faith in it.

INSTALLING.

Meters should be of as small a capacity as may be used without inviting their total destruction. It is better to take chances of an occasional burn-out, than to install meters that will run during seventy-five per cent. of their working hours on less than half load and thirty-three per cent. of the time on one-quarter load or less. Under these circumstances meters, as we know them, cannot be expected to do the supply company justice.

It is impossible to entirely eliminate friction in meters, and they stand on the order of their going as it were. They are also slow on light loads. The most effective remedy is to use small meters It is true that they are also slow on high loads, but the high loads seldom come and never stay long.

The importance of using small meters may be fully realized by reference to an experiment reported by Mr. Lyman C. Reed, where a load varying from one to ten incandescent lamps was passed through two meters in series, one of 7½ amperes capacity, the other of 100 amperes. The small meter registered thirty per cent. more than the large one.

Mr. Duncan suggests the following rule for his meter:

For	3	to	7	lights install a	5	light meter.
	8	"	14	" "	10	" "
	16	"	20	" "	15	" "
	25	"	35	" "	25	" "
	40	"	65	" "	50	" "
	70	"	100	" "	75	" "

No hard and fast rule can be laid down; much depends on the class of consumers to be served. In private residences, for instance, a ten light meter would do up to twenty lights, a twenty light meter up to thirty-five lights, and a forty light meter up to seventy-five lights in the majority of cases.

It has been suggested to put two meters in parallel on large installations, one large and one small meter with a mercury switch actuated by the current and intended to automatically cut out the large meter whenever the load fell below a predetermined amount. The suggestion is worthy of consideration.

Great care must be exercised in carrying meters through the streets. A light express wagon with a box partly filled with straw, wood fibre or other packing, in which the meters may be placed on their backs, is a good thing to move them in. They may be safely carried by hand, also on a bicycle, but in the latter case the rider must be careful to avoid sudden jars.

Whenever a meter is taken out for installation the reading should be taken and left on record in the meter room, in case the reading or "start" is not taken at the consumer's premises.

Meters should not be installed on shaky partitions or those containing doors liable to slam, or on walls subject to vibrations. They should be in a dry place, easy of access and open to daylight or otherwise lighted, and, if possible, they should be protected from extremes of temperature. Meters should not be placed on or too near the floor, nor too high. You cannot expect your meter reader to stand on his head or to carry a step-ladder. In such cases he will attempt to get the reading at a distance and probably get it down wrong.

A little missionary work among electric wiremen and contractors will lead, in time, to the practice of arranging a place for the meters in accordance with the above recommendations.

Before connecting the meter it is well to try lamps here and there about the place, leaving meter loop open, to make sure that there are no branches taken off outside of the meter.

Meters should be levelled and rigidly fastened to the wall. After installing the meter, one or more lamps should be turned on to ascertain that the meter starts readily. For this purpose meter cases should have a window through which the movements of armature or shaft can be seen.

No openings should be left between the cover and the back of the meters where insects may go in. They seem to find comfortable quarters there, and spiders weave their webs around the moving parts, retarding and sometimes stopping the meter. This is more likely to happen where houses are vacated during the summer holidays. The writer has used a stick of pine wood about four inches long, one-quarter inch wide and one eighth inch thick between the cover and back casing of Schallenberger meters, at the top, with good success. It has been suggested to squirt soft putty with a syringe, so as to practically seal the cover to the back, but this is seldom necessary. It is a commendable thing, however, as it excludes dust as well as insects.

The connecting wires should be pulled through the binding posts until no bare copper is accessible from outside the meter case. The cover over the binding posts should be sealed with a lead seal bearing the mark of the meter department. It should be the duty of employees installing meters to see that there are no bare places or cut-outs on the mains between the meter and the service switch and main cut out, and to see that the latter is supplied with copper tipped fuses of the right size properly put in.

READING.

Meters should be read monthly if practicable, as "short accounts make good friends," but the large amount of clerical work involved in this practice often makes it preferable to have only quarterly readings. However, this makes very heavy bills in winter, which is objectionable. A good plan is to divide the six summer months, May to October, inclusively, in two periods of three months each, and the six winter months in three periods of two months each. The shorter winter periods will make the difference in the bills less pronounced and facilitate the collection of accounts. This compromise is confidently recommended as one that works well and gives satisfaction to consumers.

The dates of the readings should appear on the bills, as they will show the number of days covered by the amount and frequently explain apparent overcharges.

Reading meters correctly is not as easy as it looks. Men should be trained in the work and not changed unnecessarily. An unreliable meter reader is dear at any price. Errors in reading are mostly due to the fact that each dial is read by itself. Experience teaches that when a pointer is near a number, it is necessary to consult the next lower dial to determine whether the first pointer is short of or past the number. That is because the pointers are sometimes blunt, improperly set, or have a little side play. A plan which has been very successful in preventing errors, is to furnish the reader with books printed with fac-similes of the dials of a meter. The reader does not read in the ordinary sense, he merely copies in his book the position of each pointer, which is represented by a pencil stroke. The reading is done in the office.

A great saving of time may be made by using numbers to designate customers. Thus the meter reader would enter a reading taken at "A. G. Richardson, 319 Waverley street west" as "958, Richardson." The number is the page of Mr. Richardson's account in the ledger, and the addition of the surname makes identification of the reading more certain.

The clerk entering the readings in the meter ledger should make each day a list of all readings which appear quite wrong from his knowledge of customers and their previous record in the ledger. This list would then be sent to the meter department with instructions to re-read the meters. Many errors will be corrected in this way before the bills are sent out, and meters that stop will be detected.

Consumers sometimes complain that their bills are too high, and some have been known to express the opinion that the meters ran too fast, but the writer once encountered a consumer who said his meter was too slow; that was in Ottawa.

When complaints are made, it is a good practice to get an extract from the complainant's account showing the total net cost of the light for a year. This will often be a pleasant surprise to him, as he has likely figured it out in his mind by taking his highest bill and multiplying it by the number of readings in the year, forgetting the summer bills.

The period complained of should be compared with the corresponding period of the preceding year, if possible, and the preceding period should be investigated to see if meter was not under-read. In any case, offer to re-read the meter. If the first reading is confirmed and the bill really seems wrong, it is better to change and test the meter.

When a customer makes general statements as to the small quantity of light he has used, you should get him down to details. Figure out with him the probable use of each lamp or group of lamps separately. Hold him down to facts. When you come to add it up he will be surprised, and the meter will generally be found to be not such a liar after all.

STATION METERS.

The practice of metering the output of the central station, which is becoming quite popular, is a move in the right direction. The data obtained through the use of station meters is not otherwise available. It is sure to lead to economies in the station, and will be of material assistance in making and re-adjusting rates.

METER RATES.

In inaugurating meter rates, it has been customary to copy the practice of the gas companies, sanctioned by long usage, of a single rate, with or without discounts off large bills. The conditions under which electric light generating plants operate are, however, very different from those of a gas plant. The gas plant is fully utilized, and works at the point of highest efficiency for as many hours as may be desired, storing the product that is not immediately required. For an electric light plant the contrary is the case.

Forced to run our plant from sixteen to twenty hours per day at a small percentage of its total capacity, which must be such as to meet the large demand which will be made upon it for a few hours every day, we find that the great bulk of our expenses are incurred, not in running the plant, but in getting ready to run.

The charges assumed for each consumer connected to our lines, in order to be ready to supply him, are fixed, whether the lights are to be used ten minutes or ten hours per day. The cost of supplying current after the first ten minutes is only from one-third to one-sixth of the fixed charges previously incurred.

It is easy to understand, therefore, that a consumer using his lights only a short time every day, which is likely to be during the period of highest load at the central station, may not be a source of profit and may sometimes be a source of loss.

Does it not seem reasonable that this consumer should pay such a meter rate that his yearly payments shall cover the fixed expenses made on his account according to the number of units held in reserve for him and subject to his call?

This rate being applied to all consumers for, say, the first hour of the use of their lamps, would fully protect the supply company from loss on account of fixed expenses, so that any additional current would only need to be charged with the variable expenses of running, and could be sold at such a low rate as would encourage the further use of current during the hours of light loads at the central station.

Such a method of charging for current naturally tends to lower the peak of the station load curve somewhat, but specially to build up, if not the lowest, at least the intermediate portions of it, and thereby to increase the earning power of the plant.

The above considerations have led managers of electrical supply enterprises to devise various methods of charging for current in harmony with the principle of differential treatment of consumers, according to their value to the supply company as a source of profit.

Mr. Arthur Wright, electrical engineer of the municipality of Brighton, England, who has devised a system of meter charges known as the "Maximum Demand System," wishing to show the injustice and loss involved in the old single rate plan, cites two cases, his worst and his best customers.

The first employed for his maximum requirements 177 h.p. of the generating and distributing plant, capitalized at $36,966, costing, for interest, sinking fund and depreciation only, $2,582. He used in one year the equivalent of all his lights, burning 61 hours, and paid, on the single rate plan, $823.

The other employed 1.9 h.p. of the plant, capitalized at $394 and costing $27.70 annually. He used in one year the equivalent of all his lights, burning 2,004 hours, and paid $288.

Thus the large consumer who paid $823, and who would under the single rate plan be entitled to the larger discount, was actually a source of loss to the supplier to the extent of $1,759; while the small consumer who paid $288 netted the supplier a profit of $260 on the capital charges, and the variable expenses were also much less in his case, as he received only 3,807 h.p. hours, while the large consumer used 10,797 h.p. hours.

These are extreme cases; yet if similar statistics were compiled from the records of electric supply companies in this country, many cases would no doubt be brought to light which would show the injustice to supply companies and long hour users of the single rate system of charging, in a manner almost as glaring as in the example just given.

The greatest difficulty in the way of these improved methods probably lies in the fact that customers, especially the short hour consumer, will not look at these things through our own glasses. He is not concerned about the unfavorable conditions under which our own plants are operating, and seriously objects to pay a larger average rate than his neighbor, no matter how conditions may differ. It is sometimes argued by advocates of differential rates that the supply company should leave these consumers alone and seek for business rather among the smaller but longer users; but it is well known to those who have had to fight opposition that it is advantageous to have the patronage of the large business houses and to light the more prominent buildings, mostly short hour consumers, on account of the advertising value of such installations.

Among the many systems proposed, the following are the most worthy of notice:

1. The Wright maximum demand system.
2. Differential meter rates based on the installation.
3. Two rate meters.
4. Fixed price per light to cover fixed charges wholly or in part and low meter rate.

The Wright system aims to charge the higher rate for the first hour's use of the maximum current used at any time during a given period without regard to the size of the installation.

The maximum current is indicated by the "demand indicator," an instrument invented by Mr. Wright, which is installed in series with the main current wherever a recording meter is used. It consists of a "U" shaped glass tube with a bulb at each end, partly filled with colored sulphuric acid and hermetically sealed. A strip of platinoid is wound around one of the bulbs. The current is made to pass through the platinoid strip, which becomes heated and the air within the bulb expands, driving the liquid up the other leg of the "U" shaped tube until it reaches the other bulb, when it overflows down into a branch tube, which is graduated to indicate, by the height of the liquid within it, the maximum current that has passed through the instrument; the expansion of the air being proportional to the heat developed, therefore to the square of the current. When this instrument has been read it may be re-set by tilting it until the liquid runs out of the branch tube. The cost of this indicator is about ten dollars.

In Brighton, England, where the system has been working very successfully for about three years, the rates charged were in 1898 fourteen cents per kilowatt hour for the first hour's daily use of the maximum current recorded on the Wright meter, and three cents per kilowatt hour for any additional consumption. It will be seen what inducements are offered to long hour users. This was found to be equivalent to an average rate of 6.64 cents per kilowatt hour.

The system may be modified to suit local conditions; thus the higher rate may be applied to less or more than one hour's daily use, and again this quantity may vary according to season. The Chicago Edison Co., who use this system, charge for fifteen hours' use of the maximum demand per month in summer at one cent per lamp hour. For the six winter months the rate is applied to forty-five hours' use per month. Additional consumption is charged at half rates. The Edison Electric Illuminating Co., of Boston, make the hours' use to be charged at the one cent rate vary from month to month. The hours are ten in July to fifty in January.

Whatever may be said against the Wright system, there is no doubt that the use of it or some other differential system would enable us to better compete with gas in the case of such long hour consumers as drug stores, hotels, etc.

The demand indicator will not record demands lasting less than fifteen minutes, but a consumer may require an unusual number of lights on some special occasions, and he is unwilling to have his bill increased by an amount out of reasonable proportion to the privilege required. In cases like that, experience has shown that it is necessary to read the indicator before and re-set it after this unusual demand, and to take no account in the bill of this special maximum. This proceeding in a large city would involve considerable expense and trouble and complicate the system somewhat.

When the indicator has been read and re-set there is no record left of the indication except in the company's books which may lead to disputes with consumers difficult to adjust.

A device intended to combine with an ordinary recording meter the advantages of a demand indicator has been put on the market by Mr. Edward Halsey, of Chicago. It can be applied, it is said, to any meter using magnetic drag as a retarding device. The armature shaft is divided horizontally in two parts and they are connected by a ratchet coupling. The upper part carrying the armature has a pointer rigidly attached to it, and the lower part carries the copper retarding disk, which is graduated. The pointer normally stands at zero over the copper disk. The operation is a follows: As the demand increases the speed of the shaft and the magnetic drag also increase. The lower part of the shaft lags behind the upper part by an angle dependent on the torque or the energy passing through the meter, the ratchet coupling maintains the angle between the parts when the current is afterwards reduced, and the position of the pointer over the copper disk may be read as the maximum demand.

Another method of charging, probably ante-dating the Wright system, and aiming at the same results, consists in charging the higher rate on the first hour, more or less, of daily use of all the lights installed.

While this method removes the necessity of the extra meter or indicator it is open to several objections.

It puts a large burden of charge on the short hour consumer and discourages the installation of lights with the probable effect, that the consumer will install electric lights where the daily use of them will warrant this proceeding and employ gas or some other illuminant for the lights that are seldom used. While this may cause no direct loss to the supply company, it is not conducive to the popularity of electric lighting, which would be considered somewhat of a luxury.

It is not as equitable as the Wright system, inasmuch as our fixed charges are not governed by the total installation as much as by the maximum demand, and two consumers with equal installations may show great differences as to their maximum demand on the station. The system for instance does not discriminate between a consumer using say thirty lights (all his lights) one hour and another using ten out of his thirty lights three hours.

Residence lighting which should be specially encouraged, would be discouraged by this system.

The expense and difficulty of ascertaining the number and candle-power of the lights installed would be considerable. Constant checking would be required, involving frequent domiciliary visits by the inspector, and there would always be uncertainty as to data so obtained.

Still another variation of differential rates is found in the use of the two-rate meter of the General Electric Company. This meter has two sets of registering dials and armature is connected by a clutch by one or the other, at any predetermined time, by the agency of a clock contained in the meter and automatically wound up by the current.

Thus, the left hand dials for instance will record the consumption taking place during the few hours of station peak, which will be charged at the higher rate, and the left hand dials will record the consumption at all other times, which will be entitled to the lower rate.

This system does not discriminate against the short hour consumer to the same extent as the two systems previously described; he is only charged the higher rate for such use as coincides with the station peak, and only to the actual amount of such use from day to day, and in its tendency to straighten out the station's load curve it is the equal of the other systems.

Those short hour consumers whose local peak never coincides with the station peak would, under this system, get a lower rate, which is no doubt quite just.

The two rate meter does not need re-setting and preserves its record so that errors in reading may be rectified at any time.

The meter costs about $25 more than the ordinary recording meter.

There is a class of consumers that are undesirable under any system of meter charges. I refer to the very small consumers who use less than $10 per year, and while an electric supply company may not refuse any business without inviting public criticism, there should be a minimum charge of $10 and upwards per year for each customer.

In some cases the minimum is made large enough to cover the fixed charges, or a large percentage of them, and a very small meter rate is charged in addition. This is a sort of compromise between the flat and meter rates, and should be a popular plan for certain classes of customers.

It offers to the consumer the advantage of knowing practically the amount he will have to pay and equalizes the winter and summer charges, and the small meter rate will prevent useless burning of lights. It is not a system suitable for general application, but it may well serve, however, as a transition from the flat to the meter rate, and might be tried with advantage by those charging flat rates exclusively.

There is so much to be said for and against the various systems which have been proposed, that supply companies still charging a single meter rate find themselves face to face with a very difficult problem. With so many things to choose from, it is perhaps a case of "how happy could I be with either," or they hesitate to make a change which may cause them temporary loss of revenue. The single rate certainly has the advantage of simplicity and is thoroughly understood by consumers, but so long as it will be used, so long will it be necessary to make special contracts of all kinds, and the flat rate will continue to flourish with more or less vigor.

In conclusion it should be said that meters and meter rates is too broad a subject to be treated satisfactorily within the limits of a convention paper. If the two topics had been separated and each formed the title of a separate paper, the results would no doubt be of greater value to the members of this Association.

LONG BURNING ENCLOSED ARC LAMPS.

By Wm. A. Turbayne, Hamilton.

THE major factor of expense coupled with the operation and maintenance of arc lamps arose from the necessity of frequently renewing the carbons, which, in the sizes adopted in practice, had a life of some seven or eight hours only. As the all-night lighting of streets demanded that lamps should be capable of giving an uninterrupted service of from twelve to fourteen hours burning, various means were devised whereby this period could be covered by a single trimming of carbons. Innumerable types of lamps were designed with this end in view but there remained to be adopted as standards the double carbon lamp, which burned two successive pairs of eight hour carbons and, as an alternative, the single carbon lamp fitted with circular or elliptical carbons of sufficient cross section to insure a life of fourteen or sixteen hours.

Aside from the matter of trimming, however, the carbons themselves were a source of heavy expense, and early endeavors were made to perfect some means whereby their life could be materially prolonged without at the same time incurring a sacrifice of the light. It was clearly understood that the rapid wasting away of the carbons was caused mainly by their combustion or oxidation in the open air, and it naturally occurred that if the arc could be maintained in a transparent chamber, from which the oxygen of the air had been excluded, that this combustion would cease and that then the only waste would be that due to vaporization.

Experiments along these lines were conducted and the results would undoubtedly have been encouraging had it not been chiefly for the fact that, in burning in an enclosing chamber, such a deposit soon accumulated on its inner surface as to seriously obscure the light and thus render the arrangement unpractical and, therefore, as these attempts to increase carbon life proved futile, fourteen or sixteen hours per trim was, until very recently, accepted as the burning period of an arc lamp.

The great demand within the last eight or ten years for interior arc lamps operating from incandescent lighting circuits was met by a marked improvement in carbon manufacture, until finally a practically pure article was obtainable, the advent of which made possible the maintenance of an arc in an enclosing chamber and allowed of the development of the long burning lamp as we have it to-day in which a carbon in size equal to the eight-hour carbons of open arc lamps has a life of one hundred and fifty hours or more.

This longevity is effected by the method which failed some years ago on account of the lack of sufficiently pure carbons; in short combustion is prevented by a removal of the oxygen from the space immediately surrounding the arc, the oxygen not being literally removed by exhaustion, but rather by a process of chemical conversion wrought by the action of the arc itself. The carbons are surrounded by a glass globe of small area, closed at the base and only sufficiently open at the top to allow of a free passage of the upper carbon. On the formation of an arc the air contained within this globe is heated and rarified, the surplus finding an outlet through the upper opening; the remaining oxygen is reduced by combustion with the carbon to carbon monoxide (C.O.), a gas which is somewhat lighter than air, having a specific gravity of .969, and although combustible will not support combustion. This, together with the nitrogen which is liberated, completely fills the chamber and prevents further combustion of the carbon, although a small amount of air diffuses through the upper opening—a condition essential to satisfactory operation, as otherwise the vaporized carbon would condense and appear as a sooty deposit on the inner surface of the globe, while as it is, the oxygen of the entering air unites with this vapor and forms a gas. A slight deposit of silicon accumulates, which, however, does not seriously absorb the light, and which may be readily wiped off during trimming.

As a result of the absence of oxygen in the enclosing globe the ends of the carbons do not become tapered by burning but remain flat and blunt, and the device could not be adapted successfully to the existing lamps in use, which maintain a potential difference of some 45 volts across the arc, as, in the small separation of one-eighth inch or under consequent upon this voltage, too much of the light would be intercepted by the lower carbon. It was therefore imperative, in order to obtain proper distribution, that the carbons be more widely separated, and it was found that in the enclosure an arc of approximately ⅜ inch in length could be maintained with an E.M.F. of some 75 or 80 volts. Meanwhile it is necessary that the current employed should not exceed 6½ or 7 amperes, for obvious reasons associated with the cleanly burning of these lamps for long periods, and in order further that the watts expended may correspond with those expended in an open arc lamp of like rating. While a so called 2000 candle power lamp of the latter type operates with a current of 10 amperes at an E.M.F. of 45 volts or 450 watts, an enclosed lamp of like rating may operate at 6.5 amperes and 70 volts, or at 5.5 amperes and 82 volts, the higher E.M.F. and reduced current resulting within certain limits in better operation.

Enclosed arc lamps in general require special features in the feed mechanism, although the governing principles are identical with those obtaining in the open lamps. As it is necessary to separate the carbons from ⅜ or ½ inch it is usual to have the magnets act directly on the upper carbon without the intervention of levers, and this calls for a long range magnet of considerable power. In order also to obtain good regulation it is desirable that the moving armature be of considerable weight, as compared with the weight of the carbon to be lifted, as therefore decrease in weight of the carbon is not accompanied by an appreciable lengthening of the arc.

Enclosed lamps will operate efficiently in series on direct constant current circuits employing currents not greater than 6.8 amperes, and on alternating current circuits in conjunction with constant current transformers. In these instances the lamps must be of the differential or shunt feed type, and must be further provided with short-circuiting cut-outs such as are found in the well known open series lamps. A similar type of lamp is required for operating in series multiple on street railway and power circuits, but in place of the short-circuiting cut-out a device for shunting a resistance, equalling that of the arc, across the terminals is used in order that if one or more lamps cut-out or proved defective the current traversing the remainder would not rise. It is necessary also that a steadying resistance be placed in series with each group of such lamps.

Enclosed lamps for operating in parallel on direct and alternating current incandescent lighting circuits require a very simple feed mechanism and contain neither shunt magnets nor cut-outs. For adjusting the carbon a single magnet only is required connected in series with the arc. Such a magnet responds to variations in the current strength and tends to maintain this factor constant irrespective of variation in terminal voltage, but as this latter is a constant factor the magnet therefore in keeping the current factor constant must likewise keep the arc resistance and length constant also.

A retarding device such as a dash pot is required in these lamps to allow of a gradual separation of the carbons, alternating lamps especially demanding a comparatively slow separation.

As direct current lamps usually operate on circuits of 110 volts it is necessary to interpose a resistance in order to reduce this to about 80 volts as required across the arc, and, while this resistance wastes energy, yet it is necessary to the successful operation of the lamps. The alternating lamps are more fortunate in this respect inasmuch as a reactance coil may be placed in series with the arc which will reduce the voltage to that required across the arc with but little waste of energy. They may also be operated direct from transformers delivering the necessary arc voltage, or from economy coils, or auto-converters.

A type of lamp which represents simplicity in the extreme is that in which the separation and feeding of the carbon is effected by the expansion and contraction of a strip of metal interposed in the path of the current. Such a device, while not satisfactory when used in conjunction with open arc lamps, appears to be excellently adapted to parallel burning enclosed lamps, in which the arc is protected from draughts of air, and which feeds only at long intervals. For this particular purpose, as compared with electro-magnetic feeds, the advantages all appear to be with the thermal feed. Such lamps strike their arc quietly and slowly without being necessarily retarded in their action by dash-pots, their feed is positive, and slight frictions in the moving parts introduce no noticeable error; they may be operated at will on direct currents, or on alternating currents of either of the standard frequencies. On alternating currents the power factor of a load of these lamps would be high as compared with a load of lamps having large magnet coils and cores, and in the matter of maintenance there appears to be nothing about such a lamp to suggest repairs, although the replacing of an occasional regulating strip would be much cheaper than the renewing of magnets.

Aside from the economies of enclosed lamps resulting from the increased life of the carbons they possess other advantages peculiar to themselves. As a result of the absolute enclosure they burn quietly, being free from hissing or flaming even though not accurately adjusted, and, as it is impossible for sparks to make their exit, all possible fire risk is eliminated, a feature which meets with the unanimous endorsation of the Boards of Fire Underwriters generally.

By virtue of the long arc which is maintained more perfect distribution of the light over large areas is obtained than is possible with open arc lamps. Direct current lamps of the latter type exert their greatest illuminating effect at an angle of about 45 degrees from the vertical so that a very intense light is noticeable within a radius slightly exceeding the height of the lamps from the ground while beyond this the illumination rapidly falls away. Enclosed lamps on the other hand spread their rays more horizontally, their angle of maximum intensity being about 75 degrees, and as a result the light is more regularly diffused over a large area and does not assume the form of concentric zones of rapidly diminishing intensity.

The economy in maintenance however affords the most striking example of the advantages of enclosed lamps over the open and the gain will be clearly noted by a comparison of the two systems. As an example we may compare the maintenance costs of 450 watt open and enclosed alternating current lamps operating 10 hours per day per year of 365 days, assuming for the former a life of 14 hours per trim of carbons costing $36.00 per 1000, while for the latter a life of 80 hours per trim of carbons costing $30.00 per 1000. In this comparison the matter of interest and depreciation allowance may be dismissed on the assumption that it will be similar in each case and thus there remains to be calculated the cost of carbons and trimming.

As the open lamp requires two new carbons per trim it will in a year therefore, on the above basis of 10-hour runs per day, require some 261 pairs of carbons, costing $18.80; on the other hand the enclosed lamp requires but one new carbon per trim and in a year will consume but 46 carbons, costing $1.38, so that an annual saving of some $17.42 per lamp is effected by the use of the enclosed lamps.

The cost of trimming will depend largely upon local conditions but we may assume that one man at $2 per day can trim one hundred open lamps or one-half as many enclosed lamps, which will make the cost per trim, therefore, 2 cents and 4 cents respectively. On the 10-hour basis the trimming, therefore, will cost approximately $5.62 per open lamp per year, as against $1.84 per enclosed lamp per year, resulting in a further annual saving in favor of the enclosed lamp of $3.78, making the total saving $21.17.

With direct current lamps the saving will be in like ratio, allowances for differences in the life and cost of carbons being necessarily taken into consideration, but whether direct or alternating the advantages of the enclosed lamp are so apparent that before a great period elapses not only will they largely supplant the open arcs, but they will further enter the arena in competition with large incandescent lamps and regenerative gas lamps.

THE PROPER EFFICIENCY OF INCANDESCENT LAMPS FOR CENTRAL STATIONS, INCLUDING A DESCRIPTION OF THE NERNST LAMP.

By E. E. Cary, St. Catharines.

Few questions in the field of electric lighting are of greater importance to central station managers than that of the efficiency of incandescent lamps. This problem of suitable efficiency, many may justly think could be handled more properly by the central station manager than by the manufacturer, but it must be borne in mind that the manufacturer is in close touch with many stations and is thus able to observe the inauguration and development of theories incident to the subject. Few questions seem so thoroughly misunderstood, and yet the fault is not entirely with the central station. In the first place, only the larger companies will invest in the necessary apparatus, and surprisingly few of these will purchase enough apparatus to determine the efficiency of their lamps. The initial outlay, including photometers and instruments will more than pay for itself in the first year. In the absence of the proper outfit, the managers have to depend upon the statements of manufacturers or more often upon those of their representatives, and what is the result? Dissatisfaction. One maker will supply lamps guaranteeing them to be of a stated efficiency, and these lamps will give satisfaction. Should the next order be placed with another company and the same efficiency guaranteed, chances are strongly in favor of the second consignment not giving satisfaction, assuming the specifications call for efficient lamps. Both lots of lamps may consume the same current at the stated voltage and in reality be intrinsically equal, yet one will be thought well of and the other condemned. A situation such as this, upon the face of it, seems incredible, yet such is the daily experience of every lamp manufacturer until, by long and often costly experience he becomes thoroughly acquainted with the actual state of affairs upon the lines of all his customers.

For many years generators, and later transformers, have been rated in light capacity upon the basis of fifty watt lamps. Multiples of fifty are convenient quantities to handle mentally, though, when this unit of capacity was adopted, everyone felt confident of the universal adoption of fifty watt lamps.

It has been unfortunate that 3.1 watt lamps have become such a household term, as their use has often proven very costly to companies before experience made them alter first ideas.

Everyone will probably agree that it is desirable to use the most efficient lamps possible, consistent with fair life where current is supplied upon the meter basis. Two questions immediately arise: what should be considered fair life, and at what efficiency under conditions existing upon the lines can this life be most economically obtained. Hardly two managers will agree upon the first question, and very few have at hand the necessary information to answer the second.

Every lamp maker, however worthy of the name, has on record the results of many tests showing the average life to be expected of lamps of different efficiencies when operated at normal or at voltages other than normal. Below in table 1, will be found the efficiency and average life of lamps at various voltages. Though these results are in one sense approximate only, yet they are the average results of many tests.

Before discussing the table, it is well to state that the efficiency of an incandescent lamp is generally given in watts per candle. A lamp radiating sixteen candles when operating at fifty volts, and one ampere of current, consumes fifty watts, and has therefore an efficiency of 3.1 watt per candle. When lamps are tested for efficiency, one grievous error is generally made. The voltage is taken carefully as labelled on the lamp instead of being taken at the point of the lines where the lamp will be used. For example any lamp, whatever its normal efficiency may be, can, and often is operated at a much higher efficiency. For instance a four watt lamp is often burned at three watts, and a three and a half watt often burns at two and a half watts. This is simply to show that when a manager talks of using more efficient lamps, he may be operating at that very time, lamps at a higher efficiency than he contemplates using.

Efficiency and Average Life of Lamps at Various Voltages.

Efficiency in Watts per C.P. at Normal Voltage.	Average Life at Constant E.M.F.	98 per cent. of Normal Voltage.		99 per cent. of Normal Voltage.		100 per cent. of Normal Voltage.		101 per cent. of Normal Voltage.		102 per cent. of Normal Voltage.		103 per cent. of Normal Voltage		104 per cent. of Normal Voltage.		105 per cent. of Normal Voltage		106 per cent. of Normal Voltage.	
		Actual Watts per C. P.	Actual Life in Hours.	Actual Watts per C. P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours	Actual Watts per C.P.	Actual Life in Hours.	Actual Watts per C.P.	Actual Life in Hours.
4.5	2400	4.85	3500	4.68	2900	4.5	2400	4.34	2060	4.21	1830	4.06	1600	3.92	1400	3.8	1240	3.7	1120
4.	1500	4.31	2000	4.16	1750	4.	1500	3.86	1330	3.74	1160	3.62	1020	3.48	880	3.38	800	3.28	710
3.5	900	3.77	1200	3.64	1040	3.5	900	3.38	800	3.27	700	3.16	620	3.05	550	2.96	490	2.87	440
3.1	580	3.34	760	3.22	660	3.1	580	2.99	500	2.9	460	2.8	400	2.7	360	2.62	320	2.54	280
2.5	260	2.69	350	2. 6	310	2.5	260	2.41	230	2.34	210	2.26	190	2.18	170	2.11	150	2.05	140

If a station is using 3.5 watt lamps and had absolutely steady voltage, an average life of 900 hours could be expected. If the voltage however, is two per cent. high, this life is reduced to 700 hours, and the efficiency increased to 3.27 watts. If however, the voltage is four per cent. high the life is reduced to 550 hours, and the efficiency increased to 3.05 watts. Though the candle power is increased, the total watts consumed is not proportional and the station suffers doubly in consequence. Four per cent increase in voltage of a sixteen candle power lamp increases the light emitted about 20 per cent.

This table will probably impress on central station managers how vitally important it is to know the voltage at which their lamps are operating upon different portions of their lines. Unless the regulation throughout the system is unusually uniform, it is most profitable to have the entire system divided into sections or zones, and order lamps of different efficiencies adapted to give the life settled upon as desirable. If the fluctuations are comparatively the same in the different zones, then the same efficiency can be used, only the lamps should vary in voltage, the voltage to be used to be the same in each zone. The manager immediately states that this causes too much confusion, etc., yet it is good business, and is a no more confusing problem than many others in manufacturing. When a method like this is carried out, very black lamps would disappear, average life be greatly increased and customers would be much better pleased. Take a customer upon your lines where the voltage is four to six per cent high, not to speak of twenty per cent. as is often found, and when you replace burned out lamps what is the result; the new lamps may emit from twenty to thirty-two candles and the old lamps eight to ten. Naturally the customer complains that the old lamps are worthless, and to keep peace, you replace these also and he starts with practically all new lamps, the same trouble to be gone through with later on. In the meantime you are apt to write the manufacturer that his lamps are blackening badly and return these specimens as fair samples. Troubles arising from causes similar to this have forced manufacturers oftentimes, who cannot or will not investigate the trouble, to send out their lamps uniformly of a higher voltage than is marked on the labels. This is in one sense self protection which the manufacturer is forced to do if he wishes to retain the trade which is often at such a distance that he cannot afford to investigate personally,

Most lamps imported from the States to-day, are much higher in voltage than indicated on the label. Yet the central, station if it has not due regard for the light emitted, will be pleased with the lamps as they may last almost indefinitely. The most welcome information a manufacturer can receive is to the effect, that a central station does not wish a lamp to last forever so to speak. Consider for a moment how small the expense of the renewal item is under normal conditions. Assuming only six hundred hours average life at the low average meter rate 6/10 cents per lamp hour the income is 3.60. Good lamps can be purchased for 20c. each or less than 6% of the income.

When lights are furnished upon the flat rate basis, and the renewals are paid for by the consumer, highly efficient lamps are not desirable.

When central stations will determine intelligently the proper efficiencies of lamps which they should use, and take means to hold manufacturers to their specifications, then their lamp renewal account will considerably decrease and the legitimate lamp maker prosper proportionally.

Below is given another table of current in amperes taken by lamps at various voltages and candle powers at different efficiencies, which may be found useful for reference.

CURRENT IN AMPERES TAKEN BY LAMPS AT VARIOUS VOLTAGES AND CANDLE POWERS.

3.1 Watts per Candle.

Candle Power.	50 Volts.	55 Volts.	80 Volts.	95 Volts.	100 Volts.	105 Volts.	110 Volts.	1 0 Volts.	220 Volts.
8	.50	.45	.31	.26	.25	.24	.23	.21	.11
16	1.0	.90	.62	.52	.50	.47	.45	.41	.23
25	1.6	1.4	.97	.82	.78	.74	.70	.65	.35
32	2.0	1.8	1.3	1.1	.99	.94	.90	.83	.45
50	3.1	2.8	2.0	1.7	1.6	1.5	1.4	1.3	.71

3.5 Watts per Candle.

Candle Power.	50 Volts.	55 Volts.	80 Volts.	95 Volts.	100 Volts.	105 Volts.	110 Volts.	120 Volts.	220 Volts.
8	.56	.51	.35	.30	.28	.27	.26	.23	.13
16	1.1	1.0	.70	.59	.56	.54	.51	.47	.26
25	1.8	1.6	1.1	.92	.88	.84	.80	.73	.35
32	2.3	2.0	1.4	1.2	1.4	1.1	1.0	.94	.51
50	3.5	3.2	2.2	1.9	1.8	1.7	1.6	1.5	.80

4 Watts per Candle.

Candle Power.	50 Volts.	55 Volts.	80 Volts.	95 Volts.	100 Volts.	105 Volts.	1 0 Volts.	120 Volts	220 Volts.
8	.64	.58	.40	.34	.32	.31	.29	.27	.15
16	1.3	1.2	.80	.68	.64	.61	.58	.54	.29
25	2.0	1.8	1.3	1.1	1.0	.95	.91	.84	.45
32	2.6	2.3	1.6	1.4	1.3	1.3	1.2	1.1	.58
50	4.0	3.7	2.5	2.1	2.0	1.9	1.8	1.7	.91

Before describing the Nernst lamp I will say in reference to 220 volt lamps that great progress has been made in their manufacture during the past year or two, but that little further is necessary in making them more efficient before they will be on a par with 110 volt lamps. In addition to this, plants must be installed calling for a range of 220 to 240 volts before the cost of the lamps can be brought to its proper level by the manufacturer.

During the past year vague rumors have occasionally been wafted across the water of the discovery of a new light, although details of the discovery were entirely lacking until Mr. Swinburne delivered his now famous lecture before the Society of Arts in London, February 8th. I will quote from this lecture a few descriptive remarks and then give some criticisms of the lamp from other sources. Mr. Swineburne in speaking of Nernst's discovery says: "Nernst's like most great inventions, is exceedingly simple as soon as it is understood. The efficiency of an incandescent body, as far as radiation goes, depends simply on temperature of the filament only, providing there is no loss by convection. The carbon will not stand a sufficiently high temperature. Nernst therefore chose a material that would stand higher temperature than carbon, and his material has the incidental advantage, that its specific resistance is so high, that strong rods can be used for high pressure instead of thin filaments. Nernst takes highly refractory oxides as his material. It does not seem promising, because such oxides are notoriously good insulators. But such insulators are electrolytes when hot; Nernst therefore, heats the rod to make them conduct, and then heats them electrically, preserving a temperature which is within the limits that the material can bear without softening. * * * The material is worked up into little white rods. Each rod is mounted on two platinum wires, a little paste made of refractory oxides being applied to the joints. The little rod with its two wires, is then mounted in holder which fits ordinary electric light fittings. As the rods fall in resistance as the temperature increases, after the manner of electriolytes, an increase of current produces a decrease of resistance. This tends to give some instability in running in parallel on supply circuits. This instability is corrected, as in an arc lamp which has analogous properties due to a different cause by a series resistance. The Nernst rod has therefore a resistance in series. This is made up of exceedingly fine wire, and for ordinary circuits amounts to 10 or 12 per cent. of the whole resistanceof thelamp. The consumption, including the resistance is 1.5 watts per candle for large lamps, and 1.6 for small lights of low pressures. In small or low pressure lamps the loss of heat at the ends is larger in proportion.

Such a lamp as I have described will not light up of itself, for the rod is an insulator when cold. The simplest way to start it is to warm it with a match, or better with a small spirit lamp. Such a lamp as this is not only very cheap as regards first cost, but economical in running. The life of rods, running at an efficiency of two-thirds of a candle per watt, including the resistance, is already more than 500 hours in good specimens. If the Nernst lamp advances as much in the first years of its existence as the carbon lamp did between 1880 and 1882, it will soon be made so well that the rods will last a lifetime. When the rod is worn out, a new rod with its little mounts is all that is replaced. The whole lamp is not thrown away at all. The small lamps and the lamps of medium size are in practice started by a heating resistance. This is arranged close to the rod, and in shunt to it. As soon as the rod is hot enough to conduct, its current works a tiny cut-out in the resistance circuit. In large lamps the heating system is a little more elaborate, as the resistance arrangement is arranged as a sort of hood which covers the rod. As soon as the rod conducts, not only is the resistance circuit broken, but the electro-magnet lifts the little hood clear off the rod. In all these forms, the rod and its mounting are replaceable without interfering with the rest of the lamp."

The above extracts give a very clear idea of the Nernst lamp, as first described to the public by those interested in promoting a large company for its exploitation. There are however serious practical difficulties involved in the practical operation of these lamps at the present time. Assuming however for the sake of argument that the Nernst lamps can be operated successfuly in practice, the relative cost of this operation compared to arc and incandescent lamps is what chiefly interests the central station manager.

The English Electrical Review recently published an article by Mr. John I. Hall upon "The Nernst Lamp vs. The Arc and Incandescence Lamps." I quote for your information a part of this article, giving comparisons in cost between the Nernst and Arc lamps. These are the only figures that have been recently published. After speaking of various methods of lighting, Mr. Hall writes: "But at present the position of the various illuminants may be summed up as follows:—

1. The Welsbach system is an advance over the ordinary method of lighting by gas.

2. The enclosed arc lamp is an advance over the open arc.

3. The Nernst system is an advance in incandescent lighting.

The electric lamps are placed in the order they will occupy in regard to cost of maintenance, for as the Nernst lamp supersedes the enclosed carbon lamp, so does the arc lamp supersede the Nernst lamp.

Mr. J. Swineburne, in the prospectus of the Nernst Electric Light, Limited, states that: "It will, I believe, oust the arc lamp in nearly all cases." On examination it will be found that it will not oust one arc lamp at present in use, as the following particulars will show;

The Nernst lamp is said to give 1 C.P. for an expenditure of 1.5 watts. The arc lamp (2,000 N.C.P.) absorbs 500 watts and actually gives 1,200 C.P. The Nernst lamp to give 1,200 C.P., will require an expenditure of 1,800 watts, or 3.6 times more energy than the arc lamp. 1,800 watts = 1·2 kilowatts per hour, which will cost to the consumer 3·0d. per kilowatt per hour.

The arc lamp absorbs 0·5 kilowatt per hour, and this at 3d. per unit equals 1·5d. These figures are for public lighting; for private consumers the cost is, of course, increased. Allow a liberal amount for carbons, trimming and cleaning, &c., say, 0·5d. per hour, then there is 1·5 - 0·5 = 2d. per hour as the cost of the arc lamp against 3·0d. as the cost of the Nernst lamp.

The figures given above are for the open arc lamp, but for the enclosed arc lamp the cost would be about 1·6d. against 3·6d. for the Nernst lamp. In other words, instead of our corporations running their street arc lamps for, say, £18 per annum per lamp, they will, by adopting the Nernst lamp, run them at £64, or spend £40 more per lamp.

It will therefore be considerable time before the municipal electrical engineer is found who will be ready and willing to come forward and suggest the ousting of the arc by the Nernst lamp.

The Nernst Electric Light, Limited, prospectus further states that "there is no difficulty in running in parallel on 1,000-volt circuits without transformers." It will be of some interest to the electric light engineers to find the 1,000-volt circuits without transformers amongst the electric lighting stations. However, the merits of the 1,000-volt lamps can be considered as against the arc lamps.

Suppose the advantages of the Nernst lamps are considered running in parallel on 1,000-volt mains. Is there any economy in conductors to be secured under these circumstances? Take a section of, say, 20 arc lamps, with transformers, running in parallel and controlled from a substation. The current required will be

$$\frac{20 \times 500 \text{ watts}}{2{,}000 \text{ volts}} = 5 \text{ amperes primary current.}$$

For 20 Nernst lamps the current will be

$$\frac{20 \times 1{,}800}{1{,}000} = 36 \text{ amperes primary current.}$$

Thus it will be seen that, taking the most favourable conditions set down by the prospectus of the company for the Nernst lamp to compete with the arc lamp, a cable of seven (7) times the sectional area will be required, in addition to the transformer, for them to run on existing installations where the E.M.F. is 2,000 volts.

The cost of the lamp cases and posts now remains to be considered. It may be taken that the lamp-posts will cost about the same in both cases. The arc lamp complete, with hood and globe, costs, say, £6, and the Nernst lamp £1. This appears to be a fair price, allowing for promotion anticipations without actual figures as to cost.

The first cost, and maintenance for 12 months, may now be considered, voltage 2,000 lamps in parallel:—

Arc lamp and transformer, say	£12	0	0
Say cost of cables	3	0	0
Maintenance for 12 months	18	0	0
Total cost	£33	0	0
Nernst lamp and part cost of transformer situate in sub-chamber (voltage 2,000 to 1,000)	£3	0	0
Cost of cables	21	0	0
Maintenance for 12 months	64	0	0
Total cost	£88	0	0

There are other considerations of cost, such as conduits, depreciation and interest on capital outlay, which the electrical engineer will observe are not in favor of the Nernst lamp, and so they are, in kindness, omitted.

To summarise the foregoing particulars, it is pretty plainly to be seen that the rosy and light-hearted view taken by the Nernst Company as to ousting the arc lamp will need some slight modification, especially on the score of first cost and economy. Unfortunately for the new comer there are such things as cables to be taken into account and maintenance.

So, then, the manufacturers of open and enclosed arc lamps, are not yet to put up the shutters, stop the machinery, and discharge the workmen; but it is not so pleasant an outlook to the carbon lamp manufacturer unless he commences to make the Nernst type of lamp (under license, of course) or improve the carbon lamp, as will appear later on.

But there are other considerations to be taken into account where the advent of the Nernst lamp will be most beneficial, and where it will be appreciated, as we shall have for street lighting two illuminants to choose from, and where one is not applicable the other will be most serviceable.

It may be considered that for lighting large areas such as squares, public markets, &c., and main streets and roads, the arc lamp will not be superseded, but for the lighting of narrow streets, public halls, &c., the Nernst lamp will be a most valuable acquisition, on account of the increased economy in running.

In all the circumstances it must be considered that the lamp is automatic in its action, as the match-assisted lamp is out of question in 1899, excepting, of course to the promoters. The engineer and manager of one of the most successful gas works in the country said to me, when discussing the merits of the Nernst lamp: "Why, you will be going back to the old barbarous times of gas lighting if you use a match to light your incandescent lamp, and all the advantages of the enclosed filament lamp will be dispensed with.'

Before closing you will probably be interested in one or two experiments upon the Nernst lamp.

THE PROTECTION OF LOW TENSION WIRING AGAINST DANGEROUS HIGH POTENTIAL CURRENTS.

By W J Plews, Montreal

All persons in connection with electrical supply companies, especially in lighting service by alternating currents, have long recognized the necessity of some reliable apparatus to prevent low tension service wires inside buildings from becoming a possible source of danger to human life, or as regards fire, in event of contact with high tension conductors. That this condition often exists, and that the danger therefrom can hardly be overestimated, is a well known fact to all Electricians who have had experience with alternating current systems.

Some years ago, the principal element of danger was the liability of transformers to break down between the primary and secondary coils. Of late, however, conditions have changed considerably, the more recent types of transformers being a vast improvement on the older ones. While the contingency as regards transformers is not now so great as in former years, the change in the system of secondary distribution, involving as it does the use of large secondary units and a net-work of wires covering a great area, has given rise to another and if anything a more important element of danger, namely, the increased liability of accidental contact between high and low tension conductors. This change in secondary distribution has been rendered necessary from an economical standpoint, and as it is not at all likely that anyone will revert to the old system, the proper course seems to be the protection of individual equipments.

The contingencies previously mentioned have proven a frequent cause of fire, and in some instances have resulted in fatal accidents. Recognizing these dangers, various earthing devices have been contrived to cope with the difficulty. It seems, however, that the idea has been to afford protection from the breaking down of transformers only, by means of blowing the primary fuses, the inventors apparently not having taken into consideration the contingency of accidental contact between local and foreign conductors, whereby a large volume of current at a high potential may flow over the secondary apparatus and destroy both it and the protective device, in which event the protective device itself would probably become a source of fire.

Several of the cases which have come under the observation of the writer, wherein conditions as mentioned have existed, have been of such a nature that any earthing device, depending upon the blowing of a fuse for its action, would have been a positive fire hazard. One instance in particular was a cross between a fallen secondary and a trolley wire. In this case had there been any device of the type mentioned, a volume of current would have flowed through the apparatus sufficient either to destroy it or blow the secondary fuses; this latter occurring, it is reasonable to assume that the high tension current would have maintained an arc across the terminals of the cutout, (one such as generally used for low tension wiring) and produced disastrous results.

As far as the writer's knowledge extends, the principle, common to all safety devices of this nature, heretofore developed, has been to disconnect the local system from the source of danger by means of blowing fuses. This principle appears to be radically defective, the blowing of a fuse under such conditions being an uncertain element, attended at times with undesirable results.

In any apparatus designed to protect local low tension systems from currents of higher potential than they are constructed for, or expected to carry, it would seem more rational to employ a device that will automatically and instantaneously disconnect the high tension current from the low tension system to be protected, without depending upon the uncertain action of fuses. It is also believed that a device of this nature should be one in which the amount of current necessary for its successful operation is a known quantity, and that this quantity be as small as possible, so as to avoid dangerous arcing.

Considering the matter from this point of view, the writer believes that an apparatus can be constructed which will embody the desirable characteristics, and it is to this possibility that your attention is respectfully invited.

One form of such an apparatus, which is on exhibition here, is similar in action to a double pole knife switch, and is so constructed as to automatically open the circuit instantaneously, whenever the low tension wiring is brought into connection with conductors charged with dangerous high potential currents, either through a break-down in a transformer, or a cross between secondary and primary, or other high tension conductors.

The great advantage claimed for this apparatus, is that no matter how large the volume of current may be, only a small fraction is required to operate the device, and this only for an infinitesimal period of time, the device in opening, disconnecting both the safety apparatus and the interior wiring from the outside source of danger. Another advantage is in the fact that the device provides special facilities for rapidly testing the local system for grounds, without the use of other apparatus.

During the past few years many fires have originated from high potential currents accidentally traversing secondary systems and breaking down the insulating joints which intersected the junction between fixtures and gas pipes. From the manner in which first-class electric light wiring is installed at the present day, it would seem impossible for a current at a potential of say two thousand volts, to cause a rupture between secondary wiring and ground, and the writer's experience leads him to the conclusion that if the so called insulating joints properly performed their function, fires from this cause would be extremely rare.

If on the other hand low potential systems are so arranged that there is no chance for high potential currents to rupture to ground, there remains the danger of some person receiving a fatal shock while handling the apparatus.

In view of these facts, it would seem advisable to equip all low potential systems, which are exposed to the contingencies herein mentioned, with an automatic device that in time of need will operate effectively.

CENTRAL STATION ACCOUNTING FROM A BUSINESS STANDPOINT.

By P. H. Hart, Montreal.

Mr. President and Gentlemen, -Before proceeding to a description of the system of accounting which I will offer for your consideration, it seems appropriate to state a few of the reasons why a standard system of accounting for central stations ought to be adopted.

The reasons why are many and substantial.

The individual owner of a small plant is as much interested in having accurate knowledge of the condition and details of his business and a determinate method of obtaining such condition and details, as the manager or directors of a large joint stock company.

A proper system of accounting should show to the directors, manager, proprietor or other interested party (and for the sake of brevity I will hereafter refer to such parties as manager) besides the profits or losses of the business, the cost of producing what is sold, and should demonstrate this cost in such manner as to enable him to learn what the product costs in its various details, and particularly the costs separately of generation and distribution.

These being determined and ascertained in the ordinary progress of business and due account being had of interest on investment and depreciation of plant, the manager can compare costs and determine where excesses arise, whether in the generation or distribution, and the reasons therefor. It should also show promptly and definitely the condition of affairs of a business at any and for given periods, which is a decided requisite and absolutely essential to sound business administration. It should be such as to enable the manager to determine the advisability of soliciting or catering for any particular line of business that may be offered or obtainable and indicate the most profitable, and be a guide, preventing indiscriminate investment in pole line construction, apparatus, etc., and show at all times the value of the investment for such purposes as insurance, arbitration, assessment, etc., etc. With such information created, compiled and formulated in the regular progress of the business, the manager will be enabled to consider intelligently operating costs and the advantages or disadvantages of further investment.

I may here call your attention to some interesting information which appears in the 14th annual report of the Board of Gas and Electric Light Commissioners of Massachusetts, Public Document No. 35. This shows that out of 58 electric light companies operating in that state, with a total investment of over $17,000,000, five of the companies appear not to have earned expenses, and 32 have not earned sufficient to warrant the declaration of any dividend ; thus very near 10% of the electric light companies operating in that state do not earn expenses, and $\frac{37}{58}$, 63%, are not earning sufficient to make a return to the investors on their capital. Many of them, no doubt, may have believed they were doing well until a rigid system of accounting had been applied.

These commissioners are doing much to standardize the system of accounting in use by electric lighting companies in that state, and this statistical information is the direct result of a uniform method adopted by these commissioners in adjusting the statements submitted by the various companies.

Mr. H. A. Foster, who investigated in detail 160 electric lighting stations of the United States, for the United States census, in a work based on the information gathered by him in the taking of this census and recently published, entitled "Central Station Bookkeeping," regrets the lack of system in accounting shown by the various electric lighting stations which came under his notice, and lays particular stress on the necessity of accurate accounting in central station work, for obvious reasons.

In addition to other reasons for and the advantages of a standard system of central station accounting, I might say that in the event of the question of municipal ownership or purchase arising the manager should have definite knowledge as to the cost of investment, cost of operating, etc., to compare with assumed cost of municipal operation.

I will now present to you a system of accounting at present in use, having the objects above outlined in view, the results of which have been highly satisfactory, and in connection with it a system of records which form necessarily a part of a thorough accounting system. In the presentation I will indicate some of the various books and forms in use.

Central station accounting from a business standpoint should proceed from and be based upon an order system, guiding, directing and allotting in advance, the distribution of expenditure for investment, operation or maintenance and of revenue to the several distributions or sub-divisions of those general items that may be deemed desirable. And here I may say that such subdivisions should be as numerous as the several details of a business and when arranged for and determined upon beforehand, becomes, in practice, very easy of allottment or apportionment.

A written order should be issued covering each and every transaction, indicating the character of the transaction and the accounting to which the expenditure incurred therefor is to be charged, or the revenue derived therefrom is to be credited. This to be determined and declared in the order before the expenditure is made or the revenue derived.

Such system necessarily means that for every debiting entry to an account, something must be credited and all entries and accounts must result in a perfect balance, so that double entry bookkeeping is absolutely necessary to the practical working and comprehension of this system.

The system referred to herein, and partially illustrated by various forms or blanks, can be readily put into operation by any company and practically at any time desired. Under the system described as at present carried out, the accounting is eventually grouped into what may be designated as general accounts, which are kept in a general ledger. All the other accounts, subordinate to these general accounts, and forming what may be designated as the working accounts, and which lead up to and are finally grouped into general accounts, are kept in other or subsidiary ledgers. This subdivision of books or ledgers is done in this instance simply as a matter of convenience, because the volume of business is large and necessarily requires to be attended to by a number of persons ; but the principle involved would permit carrying all the accounts in one set of books if the volume of business were so small as to make that desirable.

The general accounts consist of the assets and liabilities, and may be sub-divided in accordance with the wishes of the manager —as, for instance, the asset account of merchandise might, if desired, be sub-divided into fuel, line supplies, station supplies or wiring supplies, etc., such accounts representing materials on hand for use as required, either for any addition to construction or for operation or maintenance of plant.

The asset account of plant and construction account may be subdivided into station construction, lines and poles, real estate, buildings, etc.

The feature of the general accounts is practically no different from that of any other double entry bookkeeping system of accounts. The method in which this system may vary from ordinary methods of bookkeeping is principally in what may be known as the working accounts, and it is here that the formulation of the accounting and the determination to which account work under any given order shall be entered, arises. In the forms shown will be noticed the titles of sub-divisions of the working accounts representing expenditures. They show construction accounts, operating accounts and maintenance accounts subdivided into the various details, upon which it has seemed desirable to accumulate and record information.

All orders issued involving expenditure recite thereon the account and sub-account to which the expenditures made thereunder are to be charged, and all returns of labor, material or expense incurred upon such order are reported, quoting the number of such order (all such orders being numbered serially.)

Expenditures which are continuous during the entire year, such as, for instance, labor and material and expense for the operation and maintenance of the station, or labor and material required for the trimming and inspection of arc lamps and lines, may be dealt with by orders covering the entire year or parts thereof, say monthly, the latter being preferable. Monthly orders for work of this character are preferable to yearly orders, because as soon as the expenditure authorized under an order has been completed, such order is turned in to the office or bookkeeper, marked as completed, and thereafter no expenditure can be made chargeable to that order.

It will be observed that the purpose sought to be accomplished by these orders is the localizing and sub-dividing of the expenditures to the particular parts of the work being done upon which the management deems it necessary to have accumulated and specific information. In the forms submitted, there are sub-accounts representing different parts of the operation within the station, sub-dividing it into boiler room, engine room and the electrical generating room ; similarly it sub-divides the work outside, the inspection, trimming of lamps, lines, the additions to the plant, whether within the station or outside, and also seeks to separate the different classes of service.

It is, of course, important that the returns made upon these orders be in accordance with the instructions contained in the order. Thus, for instance, an order authorizing the inspection of lines should not have charged to it or reported against it the coal consumed under the boilers, and experience has demonstrated that employees very soon become accustomed to reporting and sub-dividing their work in accordance with the designations of the orders under which they are acting, so that in practice the allotment of expenditures for labor, material or other expense becomes automatic, with the result that the bookkeeper can indicate at any time the amount expended for any sub-account. By using subsidiary ledgers for this purpose, arranged similar to blank or Form No. 1, which, as will be perceived, is a re-arrangement of the items upon the Form No. 2, and total up month by month or day by day as they may be recorded therein, the costs of each sub-account. Periodically, say monthly, the totals of these accounts are transferred either to asset accounts or to the debit of the revenue accounts, according to their character.

The bookkeeper in debiting the returns on these orders to their various accounts, must make corresponding credit to certain other accounts ; labor to credit of labor account ; material or merchandise to credit of material or merchandise accounts, sub-divided as it may be ; expense to expense account, and the totals of the credit of these accounts must, of course, balance with the totals debited to the accounts represented by the orders. When the labor is paid, the amount paid is debited to the labor account, thereby checking the accuracy of the pay rolls, which may be made up either from the returns upon the orders or by independent returns, but all labor represented by either the independent returns, time sheets or otherwise as may be used, must balance with the accounts credited as above to labor account, and debited to the accounts represented by the various orders.

In the detail working under these orders through a number of employees, means of obtaining material and making returns under and to these orders become necessary, and where a large number of employees are engaged, these necessarily require the adoption of other forms or blanks, as, for instance, the requirement of material necessitates for the execution of any order that an application be made that the employee needing that material to the store room or storekeeper, where such material is kept on hand, or through whom it will be purchased if need be. In the system described, this becomes what is known as a requisition, blank No. 6, and in filling out such requisition the employee requiring the material quotes thereon the No. of the order on which he intends using it. Similarly in making returns of labor or time, the time ticket or labor return blank specifies the order No. authorizing such labor. Blanks or forms authorizing the return to store-room of any surplus material that may have been taken out on an order, also recite thereon the order No. to which it is to be credited or upon which it is returned. In all these returns or reports, besides quoting the No. of the order, the accounting of such order is also recited, the object being to prevent the error of charging a wrong account through a mistake or transposition of the order Nos.

Revenue accounts may also and in the system herein referred to are sub-divided or classified into various accounts of service from which the revenue is obtained, as, for instance, alternating current incandescent lighting, alternating current motor service, direct current motor service, arc lighting, etc., and this subdivision may be made as minute as the management desires.

Dealing with a large number of customers, it is important that means be adopted whereby none shall escape from the grasp of the bookkeeper or collector. Therefore no customer should be connected with the service lines except under an order, as above described, authorizing such connection and supply of the service called for. Upon completion of such order, it is returned to the bookkeeper, with notation thereon that connection has been made and supply of service begun. Meanwhile, that is, as soon as the order to make connection has been issued, the contract signed by the customer upon which the order has been issued, is transmitted to the bookkeeper, who immediately opens in his ledger an account with such customer. On the return of the completed order, the bookkeeper notes in his ledger at the customer's account, the date of starting, which is also marked upon the contract. The customer's contract is not filed or put away or considered as being in operation, until such notation has been made.

As an additional precaution, when the account is opened in the ledger, a card similar to Form No. 7 is prepared by the bookkeeper, giving the customer's name, address, ledger folio and number of contract (and all contracts are numbered serially), character of service, and generally the main details of the contract and service. This card is filed according to ledger folio, and accumulates the record upon which the debit side of the customer's account in the ledger is created.

In cases where meters require to be read, these cards constitute the guide to the meter readers as to what meters are to be read. In sending out accounts to customers for service, every card must be accounted for by an invoice, and the fact of such invoice rendered noted thereon. In other words, the card is used to make out the invoice against the customer and the invoice is used to enter the account in the ledger, and every account in the ledger must be represented by an invoice.

The use of the method of making the entries in the day book and ledger from the invoice instead of making the invoice from the record book, is to hasten the transmission of accounts to customers, in order that they may not have any cause of complaint for delay in the opportunity to pay their accounts.

In practice, the invoices are made out during the month as far as possible, leaving only the final entry to be made when the amount of the invoice has been determined, so that it becomes possible to transmit a large number of accounts within practically one day after the meter readings have been taken.

The cards, in fact, constitute the history of the relations of the customer with the company, and at a glance show the variations in the use of service, for, as will be perceived, they are made to cover the year's transactions. They apply equally well for "flat" rate customers as for meter customers, though they are for recording meter readings. In the case of meter customers, they indicate the variations of use and afford a guide to the bookkeeper to inquire into the accuracy of the meter reading reported; any falling off or unusual increase in the use of the service as indicated by a reading immediately attracts the attention of the bookkeeper or billing clerk, thereby causing him to institute an immediate inquiry into its accuracy. In the case of "flat" customers, it declares at once the proper amount of the account to be rendered, by the record of the account previously rendered.

The debits to customers are credited to the several sub-divisions of the revenue accounts, that is, the customer may be using several kinds of service, the amounts for which are debited to his account, but credited each to the revenue account to its individual class of service. This results in determining the revenue obtained during any period from each kind of service, the total of all, of course, representing the entire revenue obtained and offsetting the expenditures made therefor.

Companies having to deal with a large number of customers and various classes of service, and varying discounts, resulting from special or large consumption, will necessarily require for the convenience of the cashier, a secondary or subsidiary cash book in which can be noted the special discounts or allowances made, as well as the cash received for the various classes of revenue. A form of such cash book is indicated in blank No. 8. This cash book, or rather entry book, for the receipt of cash and discounts, applies only to discounts stipulated in the contract. Other allowances, rebates or credits are made only by authority of order issued specially therefor in each case.

Assuming this system of accounting to have been properly and carefully carried out to the end of the fiscal year, we would now have before us the total revenue from the business in its various classes. On the other hand, we would have the total cost of operation and maintenance, general expense and the total expenditure on capital account for the year; taking the total revenue derived and deduct from that the total cost of operation and maintenance, will give the gross profit. From this gross profit is to be deducted the general expense. The general expense account should include only such items as are purely general. By that I mean expense which cannot be charged to any specific working account, and is purely general in its relation to the business, such as interest, office expenses, directors' fees, salaries of officials, legal expenses, travelling expenses, for instance expenses incurred in attending Electrical Association Conventions.

Deducting the general expenses from the gross profit will give the net profits of the business for the year, exclusive however, of depreciation. This question of depreciation is usually determined by the management. It always has been a much discussed question, and authorities find it very difficult to agree on a uniform method of application, the changing value of apparatus being so widely different.

However, one of the definitions of depreciations, given by Mr. E. Hartley Turner as "The re-payment of capital out of the total gross revenue earned during a given period of such proportion of the original capital outlay as has been absorbed or consumed in earning such gross revenue" is very good, could the amount so absorbed be readily determined. A definite plan, however, is to apply to property in which a residue of value under any circumstances must remain, a graduated percentage upon its changing value as representing depreciation. The amount of this depreciation, however, will be governed to a great extent by the amount of the expenditure on maintenance account.

In the presentation of this paper, I have endeavoured to follow out the question of Central Station Accounting from a business standpoint solely. With this in view, it has been confined almost entirely to the question of the method of ascertaining costs of generation and distribution, and recording from whence revenue has been derived and the methods of assuring the obtaining of all the revenue derivable. I have assumed that the important features are the knowledge of costs and the sources from which the revenue can be most profitably obtained.

The question of purchase of material and the recording of these purchases have not been touched upon, this method being practically similar to all lines of business; neither has reference been made to the obtaining or keeping of records pertaining more particularly to the Engineering Department, for the reason that this subject has been exhaustively considered in a paper entitled "Some Central Station Economies," submitted by Mr. P. G. Gossler at the annual convention held in Toronto in 1897.

Whilst, no doubt, the system herein described may appear elaborate and extensive in detail, and perhaps seem to entail expenditure for labor beyond the reach or desire of managers of small stations, I see no reason why the principle involved may not be used in any station at a slight expense. For while perhaps not requiring to employ all the sub-divisions indicated upon the blanks or forms shown, yet many of them can be utilized and put into practice with such modifications as the local conditions demand without imposing upon the manager or employees any labor or expense beyond that which can be afforded, and if I have succeeded in conveying ideas and information that may serve towards the adoption of a general system of Accounting for Central Station practice as suggested by the authorities referred to in the beginning of my paper, I will feel myself amply compensated.

PROPOSED POWER DEVELOPMENT.

The annual meeting of the shareholders of the Canadian Electric Light Co. was held in the city of Quebec on June 27th. The report presented by the directors stated that the $200,000 of capital required in virtue of the prospectus had been subscribed, that the Chaudiere Falls water power would be acquired immediately, and that the directors were in negotiation with the Council of the town of Levis for furnishing light and power. It further stated that the services of Mr. Raoul Girouard, of Cumberland, Maine, had been secured as manager, and that Mr. A. R. Henry, M.E., of Quebec, would probably be appointed electrical engineer. The directors have two plans under consideration for the development of the water power of the Chaudiere Falls, one made by Mr. J. M. McCarthy, C.E., of Montreal, and the other by Messrs. T. Pringle & Son, of Montreal. According to their figures a minimum of 5000 horse power is obtainable. Arrangements are said to have been made with the Chaudiere Valley Railway Co. to construct and operate electric railways in the counties of Levis, Bellechesse, Dorchester and Lotbiniere, obtaining power from the Canadian Electric Light Co. Directors were elected at the meeting as follows: President, John Breakey; Vice-President, Hon. L. P. Pelletier; H. M. Price, Gaspard Lemoyne, James King, R. Audette, R. Wilson-Smith, H. S. Holt and H. T. Machin.

Difficulties having arisen in connection with the carrying out of the contract for the Ragged Rapids transmission scheme at Orillia, Ont., it is probable that the work will again be opened for tender.

SPARKS.

The Robb Engineering Company, Amherst, N.S., are building two 350 horse power engines for the San Paulo Railway, Light & Power Co., Brazil.

Messrs. Eager & Sanderson, of Winchester, Ont., are installing a 500 light dynamo. The entire plant was furnished by the Royal Electric Co., of Montreal.

The warden of St. Vincent de Paul penetentiary, near Montreal, has called the attention of the Dominion Government to the necessity of installing an electric light plant.

Messrs. Grafton & Co., Dundas, Ont., are operating their tailor shops by S.K.C. two-phase motors, current being supplied by the Dundas Electric Co.'s two-phase plant.

Messrs. Steinhoff & Gordon, of Wallaceburg, Ont., will probably establish a heading mill at Tweed, Ont., and in connection therewith put in an electric light plant for lighting the town.

Price Bros., of Amqui Mills, Que., have their entire saw mills, docks and yards lighted by electricity. The plant, which was furnished by the Royal Electric Co., started up a few nights ago.

A new company, to be known as the Lorette Electric Light and Power Co., has been formed at Lorette, Quebec, and will undertake the lighting of that village and of the Indian and Parish churches; the capital stock will be $10,000.

Mr. A. A. Dion,
President Canadian Electrical Association.

A report from Barrie, dated June 20th, stated that the Royal Electric Co. had made application to the council for a franchise for an electric railway between Barrie and Allandale, a distance of one mile, with privilege to extend to other points.

The manufacturing warerooms of Mr. Geo. Bean, of Dundas, Ont., have been changed from the old motive power to electricity, the Dundas Electric Co. furnishing the current, and the Royal Electric Co. a two-phase S.K.C. motor to drive the establishment.

Dr. J. T. Nicholson, late professor of Mechanical Engineering at McGill University, Montreal, was made the recipient of a testimonial from his colleagues in the Faculty of Applied Science, on the occasion of his leaving for Manchester, Eng., where he will in future reside.

The town of Liverpool, N.S., is about to establish an electric light plant, tenders for the supply of which will be received by Mr. D. C. Mulhall, mayor, up to Friday, July 28th. The contract for constructing dam, power house, wheel-pit, conduit and tail race in connection therewith, has been awarded to F. W. Clarke, of Bridgewater, N.S.

Ald. Peck, of New Westminster, has received the appointment of Inspector of Steam Boilers for the province of British Columbia, a position created at the last session of the Legislature.

Mr. E. E. Cary,
1st Vice-President Canadian Electrical Association.

The new 75 k.w. S.K.C. dynamo was put in operation at Grand Valley, Ont., a few days ago, and is now supplying from one phase of the machine, the town of Grand Valley with 500 incandescent house lights and some 50 c.p. street lamps. From the other phase of the same machine, which is wound for a 5000 volt current, they are supplying the town of Arthur, 12 miles away, with about 600 incandescent house lights and five enclosed arc lamps, as well as fifteen 32 c.p. incandescent street lamps. This plant is one of the most unique and complete in Canada.

Mr. P. G. Gossler,
2nd Vice-President Canadian Electrical Association.

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CORRESPONDENCE SOLICITED.

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MR. W. W. GRANT.

We have pleasure in presenting to readers of the ELECTRICAL NEWS the accompanying portrait of Mr. W. W. Grant, who has recently been appointed by the Westinghouse Electric & Manufacturing Company, of Pittsburg, Pa., to act as their representative in Canada in conjunction with Messrs. Ahearn & Soper, of Ottawa. The following brief particulars of Mr. Grant's career will suffice to show his capability for this position.

Mr. Grant is a native of Ottawa, and a son of Sir James Grant, K.C.M.G., of that city. He is a graduate of the Royal Military College of Kingston, which is recognised as one of the foremost educational institutions in Canada. Owing to his standing at this institution, and the marked perseverance displayed during his college course, he was awarded a commission in the Royal Engineers of England, which is the highest branch of the British military service. After due consideration, however, he declined this offer, recognizing that there were larger possibilities in America.

After having graduated, Mr. Grant was engaged in practical work in Canada for about two years. In 1892 he entered the employ of the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., starting at the bottom of the ladder in the factory, and thence passing through all departments of the company's extensive works. In 1893 he was appointed one of the erecting engineers on the Hamilton Street Railway during the reconstruction of the road. In 1895 he was transferred from the construction to the business department of the Westinghouse Co., where he became associated with Mr Maurice Coster, who is recognized as being one of the most prominent and successful engineering salesmen connected with the company. In 1896 he removed from Pittsburg to the company's New York office, and in recognition of the value of his services during the two-and-one-half years of his residence in New York, he was chosen to fill the important position which he now occupies in Canada. There is no room to doubt that from the steady advancement which Mr. Grant has made in the past, due to his ability and faithful performance of duty, he will fully meet the requirements of his present position.

MR. W. W. GRANT.

Messrs. Taylor & Co., of Dundas, Ont., have placed an S.K.C. two-phase motor in their work shop, and will hereafter operate by electric current furnished by the Dundas Electric Co. Dundas will soon follow the lead of Hamilton, and become, with all its factories, a smokeless city.

SPARKS.

The citizens of Medicine Hat, N.W.T., are considering the question of granting a franchise for electric lighting to a local company.

The Cataract Power Co. is announced to have secured control of the Hamilton Street Railway system. As a result, it is understood that the construction of the contemplated electric roads to Guelph, Galt, Berlin, St. Catharines and other points will be undertaken at an early date.

Messrs. A. C. Miller & Co., of the steamer "Alexandria," have placed their order with the Royal Electric Co. for a complete electric lighting plant for this new steamer. The work of installation is going on now, and on completion it will be one of the best electrically equipped vessels on the lakes.

The first meeting of the shareholders of the Victoria Telephone Co., Limited, was held at Woodville, Ont., recently, at which directors were elected as follows: President, J. G. Eyres, Woodville; vice-president, J. G. Campbell, Orillia; treasurer, C. E. Weeks, Woodville; secretary, Wm. A. Robinson, Cannington. The directors decided to build lines to Beaverton, Orillia, Midland, Barrie, Lindsay, Peterboro, and other places as soon as possible.

Messrs. Geo. Wilson & Co., of St. Catharines, who operate a large planing mill and sash and door factory, where they have plenty of refuse for steam purposes, have found it cheaper and more satisfactory to operate their mill by electricity, and have entered into an agreement with the St. Catharines Electric Light & Power Co. to furnish them with from 50 to 75 h.p. They have also placed their order with the Royal Electric Co. for a 50 k. w. S. K. C. synchronous motor. There are also a number of other firms who contemplate making changes from steam to electricity.

A circular from the International Correspondence School, Scranton, Pa., states that the United Correspondence School and the American School of Correspondence have recently been established, using many of the copyrighted instruction papers of the International Correspondence School. Suit has now been entered by the Colliery Engineer Co., in the United States Circuit Court, to restrain these schools from using their papers, and for infringement of their copyright, and students are warned against having such pamphlets in their possession, in case the Colliery Engineer Co. are successful in establishing their allegations.

The St. Catharines Electric Light & Power Co. have enlarged their water power, and are in a position to furnish power and light throughout the twenty-four hours. They have lately installed a 200 K.W. S.K.C. two-phase generator, from which they are supplying light on their single-phase mains throughout the city during the hours of lighting, and during the day are furnishing two-phase alternating current to the various industries throughout the city. This company had been supplying arc and incandescent lights only, but as there was a considerable field for power, in which one plant, a 500 voltdirect current system, was already engaged, they decided to put in something which they could use for both purposes, hence they have only one investment in using the poly-phase system instead of two using the direct current power system and an alternating current lighting system

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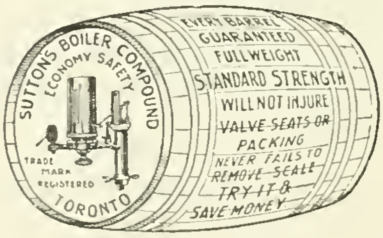

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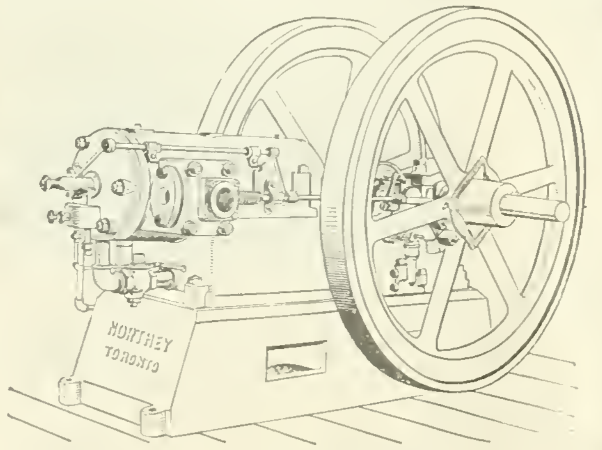

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CANADIAN
ELECTRICAL NEWS
AND
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VOL. IX. AUGUST, 1899 NO. 8.

CABLE LAYING FOR CHAMBLY TRANSMISSION LINE.

THE accompanying photographs illustrate a somewhat novel method of laying cable under unusual conditions. As may be known to the readers of the CANADIAN ELECTRICAL NEWS, the Royal Electric Co., of Montreal, for the Chambly Manufacturing Co., have installed the electrical equipment in the power house of the hydraulic development of the Chambly Manufacturing Co. at Richelieu village, on the Richelieu river, 16 miles from Montreal. They have also erected the transmission line between the power house at Richelieu and the city of Montreal.

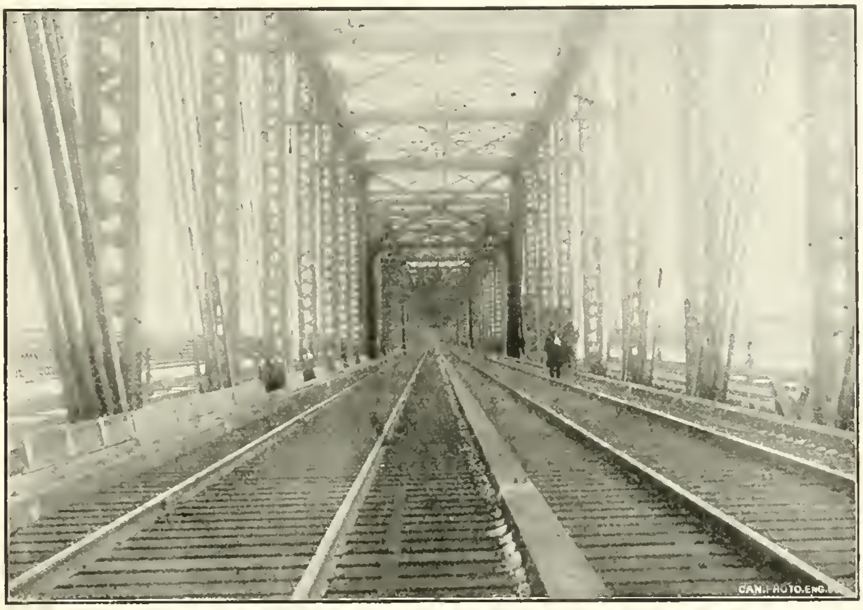
FIG. 1.—VICTORIA JUBILEE BRIDGE, MONTREAL—VIEW LOOKING EAST.

The hydraulic development will amount to 20,000 h.p., with a head of 28 feet. There have been installed four generators of 2,000 capacity each, so designed and wound to generate 12,000 volts, the latter voltage being the pressure at which the power will be transmitted to Montreal by means of a duplicate pole line, each line consisting of 16 copper wires of No. 00 B. & S. gauge. Before reaching Montreal, however, it is necessary to cross the St. Lawrence river, which is spanned at this point by the recently completed Victoria Jubilee bridge. This bridge, with approaches, is approximately 8,750 feet in length.

The transmission cables for this section of the line are laid in a wooden box placed on the sleepers, on a level with and four feet out from the steel rail. (See Fig. 2.) Each box is designed to contain sixteen cables.

In placing these cables, the somewhat unusual method of laying them by means of a locomotive and flat cars was used (see Fig. 4). Four flat cars were loaded with reels, each reel containing 1,000 feet of cable, and then jacked up into position, ready to pay out. The cable was paid out over a specially designed cast iron sheave 22 inches in diameter, which was carefully shrouded to avoid any injury to the lead sheath. This sheave is shown in Fig. 3, which also shows the cables, two in number, being paid out. The ends of these cables being securely lashed in position in the cable box, the locomotive and cars were then started and kept moving at the rate of about four miles an hour. The cable paid out over the cast iron sheave, ran back to the rear end of the car and over two wooden rollers, suitably placed, then dropped into the cable box on the floor of the bridge.

Two reels of cable (2,000 feet) were laid in five minutes, by actual count, and in eight hours 26,000 feet of cable was placed in position and ready for jointing. The major part of the time was consumed in loading and unloading cable reels and running backwards and forwards for laying cables. A section of the type of joint used is shown in Fig. 5. Great care had

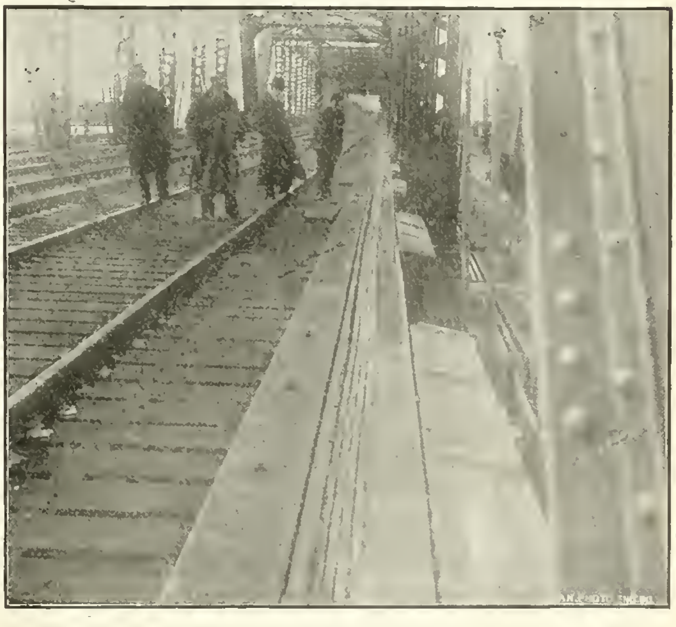
FIG. 2.—TRANSMISSION LINE OVER VICTORIA JUBILEE BRIDGE, SHOWING BOX FOR CABLE.

to be used in making these joints on account of the high voltage of transmission. The cable was made by the Washburn & Moen Mfg. Co., of Worcester, Mass., and consists of a core of 37 tinned copper wires of a cross-section equal to No. 00 B. & S. gauge, insulated with 8-32 of rubber compound. This cable is made to withstand a test of 20,000 volts for one hour, and a breakdown test of 35,000 volts.

The cable is protected by a pure lead sheath 3-32 thick, no alloy of tin and lead being used as is ordinarily done, for the reason that a sheath of pure lead would not be so liable to crystallization from vibration of the bridge structure as would be one composed of tin and lead.

We are indebted to Mr. J. A. Burnett, of the Royal Electric Company, who personally superintended this installation of cable, for our illustrations.

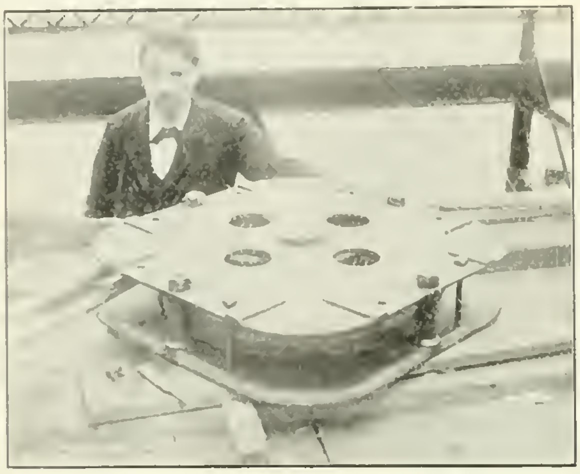

FIG. 3. SHOWING SHEAVE ON CAR.

ANNUAL MEETING OF OTTAWA ELECTRIC LIGHT COMPANY.

THE annual meeting of the Ottawa Electric Light Company was held last month. There was a large attendance of shareholders.

The annual report of the directors stated that the revenue from all sources for the year ending April 30, 1899, was $161,615. The expenses of operation and maintenance, with interest on the bonds, etc., amounted to $113,268, leaving a net surplus of $48,346.

From this surplus a dividend of 6 per cent., or $44,653 for the year 1898-99, was paid on the capital stock of $765,800, leaving a balance to go to credit of profit and loss of $3,692.

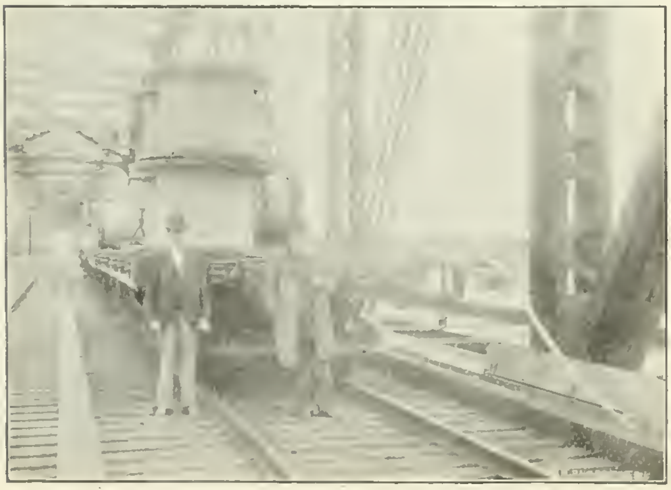

FIG. 4—SHOWING CABLES BEING PAID OUT.

During the year $57,878 was expended on new plant. The total plant is now valued in the company's statement at $1,209,438. The report was adopted, and the board of directors re-elected as follows: T Ahearn, president; Hon. E. H. Bronson, vice-president; J. W. McRae, managing director; Hon. F. Clemow, Denis Murphy, John Coates and F. P. Bronson.

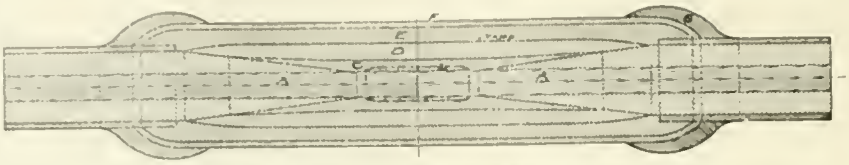

FIG. 5 WASHBURN AND MOEN CABLE JOINT USED.

A—Copper conductor.
B—Tinned copper sleeve connector.
C—Pure jointing rubber.
D—Jacket jointing rubber.
E—Compound poured in.
F—Lead sleeve.
G—Wiped solder joint.

The number of incandescent lights increased by the largest figure for any year in the company's history, namely, by 14,142. The total number of incandescent lights now in use is 77,255. The arc lights number 621.

It is interesting to note the growth of the number of lights in use, notwithstanding which the gas company has continued to flourish. The following shows the growth in the electric company's business since the start:

	Incandescent Lights.	Arc Lights.	Heaters.	Motors.
1894	42,152	440	11	81
1895	48,797	468	15	81
1896	53,331	497	19	81
1897	57,240	550	30	87
1898	63,113	599	32	96
1899	77,255	621	23	103

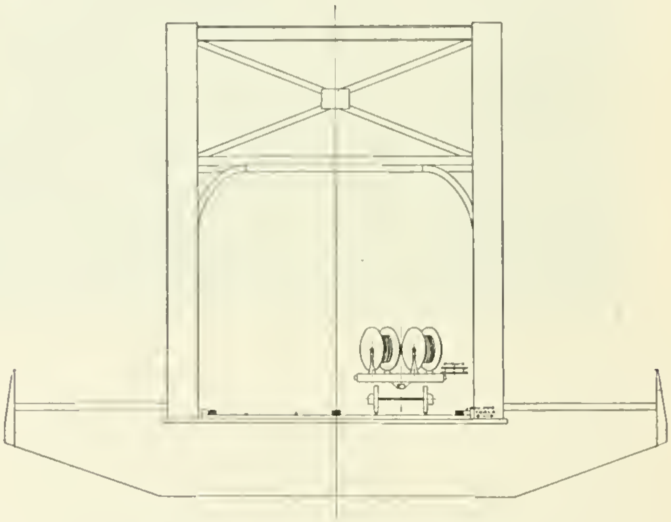

FIG. 6.—CROSS SECTION OF VICTORIA JUBILEE BRIDGE, SHOWING APPARATUS USED FOR LAYING CABLE.

An electric plant owned by Mr. Keith and stored in the building of the Iroquois waterworks at Iroquois, Ont., was burned on June 27th. The loss is about $2,000.

Of the many catalogues which reach our desk, none are more attractive and carefully compiled than those issued by the Sprague Electric Company, of New York, and sent us by their Canadian agents, Messrs. Jack & Robertson, of Montreal. These include the Lundell Motor Catalogue No. 65, the Lundell Fan Motor Catalogue No. 66, Catalogue No. 63 of the Greenfield Flexible Metallic Conduit, Catalogue of Electric Motors for Printing Establishments, and the Architects' and Engineers' Electrical Bulletin. Besides the numerous illustrations of the many lines of electrical goods manufactured by the Sprague Company, these booklets contain valuable tables and articles of interest to all users of such apparatus.

MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS,
New York Life Building,

MONTREAL, AUGUST 5, 1899.

ANOTHER TRANSMISSION PROJECT.

A RUMOR is abroad to the effect that a syndicate is to be formed for the purpose of installing an electric plant at Beauharnois to generate and transmit current for light and power to Montreal. Level-headed business men express the opinion that there is no room at present in this city for additional enterprises of this character.

STREET RAILWAY ENTERPRISE.

The Montreal Street Railway Co. have organized a band of musicians to accompany trolley excursions, which are a favorite form of pleasure-taking in this city on summer evenings. The band occupy a car specially suited to their requirements, and head the procession. Another innovation is a car with the words "Baseball To-morrow," formed of incandescent lamps, appearing in three lines across the front.

THE LACHINE RAPIDS HYDRAULIC AND LAND COMPANY.

This company are fitting up a building on Chenneville street as a sub-station, with steam boilers, engines and two rotary transformers, from which both direct and alternating current will be supplied. Direct current is required for lighting the Temple building. The steam plant will not be used except in the event of the operation of the generating plant at Lachine being interfered with by ice, as was the case last winter. The wind blowing in a direction contrary to the flow of the water caused the blocking up of the tail race with ice. This, in conjunction with the frazil ice which formed on the surface, greatly reduced the head of water and in like degree the supply of current. To avoid a recurrence of this difficulty, the company are now constructing a groin, which is expected to prevent the blocking of the tail race by ice. Steps are also being taken to overcome the difficulty arising from anchor ice.

MEETING OF ROYAL ELECTRIC SHAREHOLDERS.

The annual meeting of the sharehalders of the Royal Electric Company was held in Montreal on July 18th. The manager, Mr. W. H. Browne, made some explanations in regard to the operations of the company since its inception and during the past year. He explained that, in the electrical business, inventive genius was so prolific that the plant or apparatus for manufacturing electricity soon became obsolete. Hence, during the existence of this company $1,800,000 of equipment had become useless, or superseded by improved machinery and methods. The whole of that $1,800,000 had not been written off, but $600,000 to $800,000 had, and, while there was certainly a million dollars in the nominal assets which was really not in existence for any practical purpose, he thought the proper thing to do was to distribute the loss over a number of years, as they had been doing. Speaking of underground conduits, Mr. Browne said the time was coming, and soon they must meet the necessity. The cost of total conversion from pole wiring to conduits would be $1,500,000, but entire conversion was not necessary, as in some of the residential quarters it was not called for. He explained that, notwithstanding the large outlay for conduits, the expenses of maintenance would be sufficiently reduced to pay the interest on the outlay. He said the atmosphere of Montreal had been filled for some years not only with electricity, but with the idea that electricity would be made for almost nothing, especially when the Lachine Rapids commenced doing their work. However, this idea had been, to some extent, exploded. The Lachine Company were stiffening their prices.

The annual statement presented showed the gross receipts for the year to be $1,113,770.87, and the expenditure for labor $791,486.58, leaving a balance of $322,284.29. After deducting interest and fixed charges amounting to $54,600.11, the net revenue for the year was $267,684.18. During the year $38,603.33 was spent on factory equipment and $84,782.03 on lighting stations, lines and general construction. The report stated:

"With contracts now in hand for motive power and the increasing favor with which the use of electric power is regarded, it seems reasonable to anticipate that during the coming year there will be fully, if not more than, 2,500 horse power in capacity additional demand for current for motors from the alternating current system. Since May 31st, 1899, there has been connected with the alternating current system and now in continuous service, an electric motor of 450 horse power capacity operating a pump in the St. Cunegonde pumping station of the Montreal Water and Power Co., for the supply of water to the citizens of the municipalities adjoining this city. This is the largest electrically driven pumping plant so far established in the world. The "S.K.C." motor performing this work was built in the shops of and supplied by this company. A large number of contracts for lights and motors at present in hand are for periods of five or more years. The alternating current system for lights and motors is now operated by electric current obtained from the water power generating plant, recently completed, of the Chambly Manufacturing Company, on the Richelieu river, opposite Chambly Canton. This plant, both at the generating station and receiving station, has all been equipped by "S.K.C." apparatus made in the shops in this city of this company. The four "S. K. C." generators installed in the power house at Richelieu, each of 2,650 horsepower capacity, the largest machines of the kind ever made anywhere, indicate the extensive character of the equipment and the great manufacturing capacity of the factory."

The following directors were elected: President, Lieut.-Col. J. A. Strathy; vice-president, Mr. R. Forget; directors, Messrs. J. R. Meeker, James Wilson, A. Brunet, F. L. Beique, David Morrice, H. B. Rainville.

NOTES.

Owing to the illness of Mr. Rough, who is in charge of Mr. R. E. T. Pringle's shipping warehouse on Craig street, Mr. A. E. Payne, travelling representative, has recently been temporarily discharging the duties of the position.

The names of three of the leading hotels, formed of incandescent lamps, shine out conspicuously every night from the tops of the buildings. Several of the stores show attractive signs of the same character. In fact, electricity is coming more and more into use in this city for advertising purposes.

Messrs. Fred Thomson & Co., who make a specialty of repairing electrical apparatus, have recently removed from Chenneville street to No. 744 Craig street. They now occupy improved premises and a better location. They have entered into a contract with the Wagner Co. to keep in repair several hundred Wagner transformers installed in this city.

Mr. R. E. T. Pringle has recently opened a new shipping warehouse on Craig street—a four-story building which has been fitted up for this purpose, the stock being carefully classified and compactly arranged. The retail store on St. James street will be continued as heretofore. The Craig street establishment is in charge of Mr. Rough, who, I regret to say, has of late been incapacitated through illness.

PERSONAL.

Mr. Henry W. True has resigned his position as manager of the Peoples Light, Heat & Power company, Halifax, N.S., and has been succeeded by Mr. Robert Baxter.

Mr. Donald Robertson, who has been identified with the Grand Trunk Railway for some time, has resigned, to accept a position with the Montreal Street Railway as assistant to Mr. F. L. Wanklyn, the manager.

Mr. Harry Dalton, who at one time resided in London, Ont., has recently been appointed superintendent of the Akron Traction & Electric Co., which operates lines between Cleveland and Akron and from Akron to Kent.

Mr. Nelson Graburn, assistant superintendent of the Montreal Street Railway, is about to remove to Glasgow, Scotland, having accepted the position of superintendent of the Glasgow Corporation Tramways. Mr. Graburn had charge of the electrical equipment of the Montreal road. He has recently invented a system for thawing frozen water pipes by means of electricity.

Major John Williams, gas and electric light inspector for the London district, who died at London on June 24th, was in his 73rd year, and was widely known and much esteemed. He was born in Birmingham, Eng., and served twenty-one years in the Royal Artillery. He came to Canada in 1865, served during the Fenian Raid of 1866, and was promoted to the office of Major, retiring nine years ago. Mr. Williams served the city of London as an alderman, retiring in 1880, when he was appointed gas inspector. When the electrical inspection department was organized, he undertook these duties for his district in connection with that of gas.

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AND
ENGINEERING JOURNAL

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The Publishers should be notified of the failure of subscribers to receive their paper promptly and regularly.

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Correspondence is invited upon all topics legitimately coming within the scope of his journal

The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Automobiles in Postal Service.

WE observe that the Dominion supplementary estimates contain an appropriation for an automobile mail service between the post-office and the Union depot in Toronto. It is understood that a test has been made of a wagon propelled by electricity with a view to adopting that motive power, and that the results were very satisfactory. In the past the advocates of automobiles have experimented more with gasoline and oil than with electricity, probably owing to the greater simplicity of the former. At the present time it would appear as though electricity was about to take the lead, and that it would become more generally used for the propulsion of street vehicles. The former heavy battery has given place to one which is much lighter in construction and at the same time more rigid. It is worthy of note that the battery invented by Mr. Still, of Toronto, has been favorably commented upon by experts as meeting all the requirements equally as well, if not better than any yet invented. This battery is used in the vehicles manufactured by the Canadian Motor Syndicate.

Electrically Propelled Barges.

THE great amount of space occupied in steam barges by the boilers and engine has caused British merchants to turn their attention to the substitution of electricity for steam for their propulsion. A Birkenhead manufacturing firm has, as a result, recently equipped a new vessel with electric power, and has thereby greatly increased the carrying capacity of the vessel. The vessel is claimed to be the largest one electrically propelled in the world, being 75 feet long. The battery consists of 112 Headland storage cells, each of 29 plates, 9¼ in. high by 12 in. broad and one-half inch thick, separated by ebonite separators and placed in a lead-lined box, 16 x 21 x 14 inches. The complete cell weighs four cwt., and has a capacity of 2,000 ampere hours at a nominal discharge rate of 300 amperes. The vessel is propelled by a twin-screw propeller worked by two 40 h.p. electro-motors, each taking a current of 150 amperes at a pressure of 200 volts. A Hopkinson series-parallel controller is used for varying the speed of the vessel. This is manipulated by the steersman, and has five notches from slow to full speed. A reversing switch permits the vessel to proceed ahead or astern at each speed as desired. There is a winch or small crane on board, worked by an 8 h.p. electric motor, and taking 30 amperes at 200 volts. It has a separate controller with three speeds. It is said that the vessel greatly surpasses in speed boats of equal size propelled by steam.

The Orillia Power Plant.

MORE than ordinary interest has been shown in the project to transmit electric current from Ragged Rapids to the town of Orillia, for two reasons—first, that it is the first long distance electrical power transmission in America, if not in the world, to be undertaken by a municipality, and, second, in view of the original intention to use aluminium wire for conducting purposes. The contract for the entire plant was let in January last, since which time very little progress has been made. A few weeks ago the contractors, finding themselves unable to carry out the work, withdrew from the field, and placed the council under obligation to re-let the contract. Just as we go to press it is learned that the award has been made to Mr. P. H. Patriarche, of Toronto, at the sum of $71,000, while the original contract price was $65,000. Mr. Patriarche has given ample security, and has agreed to have the plant ready for operation by December 1st next and to substitute copper for aluminium wire. In all probability the electrical and hydraulic apparatus will be of Canadian manufacture. The progress of the work will now be watched with keen interest, as the contractors have little enough time in which to complete the undertaking, more particularly as the transmission line must necessarily pass through a rough section of country. The members of the council are no doubt well satisfied that copper is to be substituted for the proposed aluminium wire, as the efficiency and utility of that material is a known quantity; on the other hand, it is to be regretted that this opportunity to prove the advantages or otherwise of aluminium conductors is to be lost. With copper steadily advancing in price, the electrical interests should foster any step looking to the substitution of a cheaper material with equally good conducting qualities, and thus encourage the development for electrical purposes of the many valuable water powers of Canada.

Niagara Falls Power Development.

ATTENTION is again directed to Niagara Falls, owing to steps having been taken during the past month which are likely to result in the further development of that immense power. Upon representations made by the Ontario government, the Canadian Niagara Power Company agreed to surrender the monopoly held under the agreement of 1892, in return for certain concessions. That agreement, as is generally known, gave the Canadian Niagara Power Company a monopoly of the water power for practically one hundred years, at a rental of $25,000 per year for the first ten years, afterwards gradually increasing to $35,000 per year. During the intervening seven years absolutely nothing was done towards developing the power. A new agreement with the Canadian Niagara Company has now been entered into, the advantages of which are that it does not embody an exclusive franchise, and that in place of an annual rental a tariff of rates has been decided upon. The company is to pay, for the first 10,000 horse power developed, $15,000 per annum; for the next 10,000 horse power, $1 per horse power per annum additional; for the next 10,000 horse power, 75 cents per horse power per annum additional; for the remaining power developed up to 100,000 horse power, 50 cents per horse power per annum additional. The agreement, which is to remain in force for 50 years, contains clauses giving to the government the right at the end of that period to re-adjust the rental if such a course is considered advisable. Should the government and the company fail to arrive at a satisfactory agreement on this point the change in rental is to be decided by arbitration. At the end of the 50 years the agreement may be continued for two further periods of 20 years, the rentals, in the event of the government not demanding a change, to remain as fixed at present. It will thus be seen that should the company develop only 20,000 horse power, the revenue to the government would be equal to that stipulated in the former agreement, namely, $25,000 per year. The company claim, however, that it is their purpose to develop 100,000 horse power, from which the annual revenue to the government would be $67,500. From the standpoint of the government, therefore, the new agreement would seem to be preferable to the old one. Another point which must be considered is the interests of the cities, towns and villages which might be benefitted by the development of the power. Will the new agreement hasten or retard the commencement of operations? It would seem only reasonable to suppose that the competition which is now made permissible would tend to cause the company first in the field to complete its works, and thus, by supplying the demand for current, shut out competition which otherwise would be encouraged. It is a source of congratulation to learn that within the past week Professor George Forbes, F.R.S., the distinguished electrician of London, Eng., who was consulting electrical engineer for the Cataract Power Company during the construction of its works on the American side, has been in consultation with Mr. Rankine and other members of the Canadian Niagara Falls Power Company relative, it is said, to the transmission of power to Toronto. The statement is given out that it is proposed to develop 100,000 horse power, at a cost of between two and three million dollars, although it is improbable that any definite decision has yet been arrived at. Mr. Forbes has just returned from Egypt, where he spent eight months preparing plans for the development of the water power of the Nile river. He is about to leave for India on a similar mission.

ELECTRICAL MACHINERY IN JAPAN.

THE United States consul at Osaka says that the manufacturers of electrical apparatus in the United States control the Japanese market.

"Electrical engines are imported from the United States, and they are giving general satisfaction. Telegraphic machinery was imported into Japan during 1897 as follows:

United States	$2,301
Great Britain	1,102
Germany	691

"But little came from any other country. The Japanese government owns both the telegraph and telephone service.

"It is said that considerable delay has frequently occurred in the execution of orders from Japan for electrical machinery in Europe, and that, in consequence, the American market has been given the preference, with the result that the superiority of such machinery has been fully established. The more direct communication between the United States and Japan, together with the lowering of overland freights, should stimulate manufacturers of machinery to increased effort for this market."

LIGHTING THE PYRAMIDS BY ELECTRICITY.

A PLAN is now said to be under consideration by the British government for the lighting of the pyramids by electricity, and the installation of an electric power transmission plant of 25,000 horse-power. The plan involves the erection of a power generating plant at the Assouan Falls on the River Nile, and its transmission over a distance of 100 miles, through the cotton-growing districts, where, it is thought, the provision of cheap power from this source will permit the building of cotton factories. Part of the scheme contemplates the lighting, from this source, of the interior corridors of the pyramids, and also the operation of pumping machinery for irrigating large areas of desert lands along the Nile. It is also stated than an American company is likely to receive the contract for this work,

TELEGRAPH and TELEPHONE

REPAIRS TO SUBMARINE CABLES.

By F. A. Hamilton, M.I.E.E., M.Can.Soc.C.E.

One of the most unsatisfactory features in connection with the repair of submarine telegraph cables, more especially in deep water, is the lack of any means of knowing if the line is intact after the two ends of the conductor are connected and whilst the joint and final splice are being made. Unless special precautions are taken, the danger of the cable becoming kinked and broken whilst the operation alluded to is being performed is imminent. To slip a final splice in deep water some hundreds of miles from land, and on arriving in port to find the cable broken, where it was supposed to have been repaired, is mortifying in the highest degree. Happily, such cases are not of frequent occurrence, but the fact of their happening at all is sufficient to suggest the necessity for some preventive measures.

A special type of cable, or the ordinary kind specially prepared, should be provided, a length of which could be kept in readiness to be spliced on to the sea end when the cable is lifted and found O. K. to the shore, when, instead of buoying the old cable, a piece of the special type should be spliced on and paid out to a sufficient distance to insure a good riding cable, which should be buoyed "end up."

Communication with the shore on the other side of the fault being established, and whilst the process of filling in the gap is being proceeded with, the cable in the tank might be cut a flake or two down and the end passed up and spliced to the special cable, so that the latter would take the bottom before the ship reached the cable buoy. The final splice would then be made on the two parts of special cable, which should be free from the springy, objectionable features of the ordinary types that are so liable to become kinked.

A strand cable, such as the 1869 Atlantic type, with a hard serving of spun-yarn applied over the manilla covered wires, would afford an excellent form of special cable and one that could be buoyed "end up" with perfect safety.

As an instance of what has been done in this direction, it may be mentioned that the writer's suggestion in respect to preparing a cable for buoying in the manner indicated was successfully carried out during a deep sea cable repair in 1888.

The cable was a hempen one and was buoyed "end up" in 1800 fathoms and in 1966 fathoms to the westward of longitude 26. On one occasion the buoyed cable was left for three days, during which period it rode out a fresh gale with lumpy sea, conditions which would have told hard on the ordinary type of cable.

If the details of a former repair to the same cable—to the westward of the position named above—during the year 1882 were given, the evidence would amply substantiate the statement here made, that the dangers and difficulties experienced in repairing operations in deep water are due in a very large degree to the type of cable employed.

That the subject is of no ordinary importance is evident from the fact that the repairs to the 1869 Atlantic cable during the year 1882 cost over £100,000.

An account of those repairs would be an interesting and instructive story, but as the subject of the present paper is not of an historical character, the particulars of the operations mentioned can be reserved for a more convenient occasion. The question now is whether the fact of a cable breaking whilst the final splice is being made can be known on board the ship.

Careful bearings of the mark buoys will sometimes indicate that the cable has severed on one side of the bight, as the ship may then drift out of line, but this would not occur if the vessel were bow on to a current setting along the line of cable. It has been a common practice with the writer during repairs to cables in which the working current was sufficient to render the conditions favorable, to use a telephone in circuit with a coil of wire —known as Gott's wire finder—the coil being placed longitudinally against the cable, so that the signals in the latter could be read on the telephone whilst the final splice was being made in the cable, and the fact of the line being intact would be known. But on long cables on which the working current is too feeble to produce inductive effects sufficient to render the signals audible on the telephone, some amplification of this method is necessary, and the following suggestion is therefore submitted.

If when a final splice is being made, a long bight of the cable were coiled around a suitable drum, provided with a coil of insulated wire with a sensative galvanometer in circuit, by using a battery power stronger than the ordinary working current, it would be possible, by means of preconcerted signals from each station, to ascertain on board the ship whether the line were intact or not.

With regard to the coil of cable, there would be no difficulty in straightening it out when the time came for slipping the bight.

In offering these suggestions the writer desires to express his regret that circumstances prevent his entering into details at present, but he hopes in a future communication to submit further particulars on the subject.

Halifax, N.S., June 21st, 1899.

SHORT-CIRCUITS.

Pare & Pare have disposed of the business of the Citizens' Telephone Co., at Granby, Que., to the Bell Telephone Co.

The ratepayers of Almonte, Ont., will vote on a by-law on September 25th next to raise $30,000 for the establishment of an electric light plant.

The Dominion government have just awarded the contract for the construction of a telegraph line on the north shore of the St. Lawrence, from the Romaine river eastward to Baie Chateau, Strait of Belle Isle.

The North American Telegraph Company's line along the Kingston & Pembroke and Bay of Quinte railways has been sold to a syndicate, and Mr. W. Banfield has been appointed manager. The company purpose extending their lines.

The business men in the county of Charlotte, N.B., purpose establishing a telephone line, taking in St. Andrews, Pennfield, Beaver Harbor, Deer Island and other points. Messrs. Connors Bros., of Black's Harbor, and Capt. Samuel Dick, of St. George, are behind the scheme.

During the past twelve months extensive improvements to the Great North Western Telegraph building, corner St. Sacrament and St. Francois Xavier streets, Montreal, have been under way. These are now completed. The building was originally constrncted in 1872 by the Montreal Telegraph Co., and was considered one of the most substantial and imposing business structures in Montreal. About one year ago the management resolved to remodel and refit the structure in a manner that would put it abreast of the times. The work was done most thoroughly, but without interfering with the company's business. New systems of drainage, plumbing, lighting and heating have been introduced and an electric passenger elevator put in.

MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H. M.	H. M.	H. M.
1....	P.M. 7.40	A.M. 1.30	5.50
2....	" 7.40	" 2.20	6.40
3....	" 7.40	" 3.20	7.40
4....	" 7.40	" 4.00	8.20
5....	" 7.40	" 4.00	8.20
6....	" 7.40	" 4.00	8.20
7....	" 7.40	" 4.00	8.20
8....	" 7.40	" 4.00	8.20
9....	" 7.40	" 4.00	8.20
10....	" 7.40	" 4.00	8.20
11....	" 8.00	" 4.10	8.10
12....	" 8.30	" 4.10	7.40
13....	" 9.10	" 4.10	7.00
14....	" 9.50	" 4.10	6.20
15....	" 10.50	" 4.10	5.20
16....	" 11.00	" 4.10	5.10
17....	" 11.50	" 4.10	4.20
18....	....	" 4.10	3.20
19....	A.M. 12.50	.....	
20....	No Light.	No Light.	.....
21....	No Light.	No Light.	.....
22....	No Light.	No Light.	.....
23....	No Light.	No Light.	.....
24....	P.M. 7.10	P.M. 9.30	2.20
25....	" 7.10	" 10.00	2.50
26....	" 7.10	" 10.50	3.40
27....	" 7.10	" 11.30	4.20
28....	" 7.10	A.M. 12.20	5.10
29....	" 7.10	" 1.00	5.50
30....	" 7.10	" 1.10	6.00
31....	" 7.00	" 2.10	7.10
		Total.........	163.10

PROF. R. J. DURLEY.

The portrait on this page is that of Prof. R. J. Durley, B. Sc. (London), who has recently been appointed to the Chair of Mechanical Engineering in McGill University, Montreal, as successor to Dr. J. T. Nicholson. Prof. Durley received his early education at the Modern School, Bedford, Eng., a school whose history goes back for considerably more than three centuries. Upon leaving, he entered the engineering department of University College, Bristol, and worked there during the session of 1884-85. While here he secured one of the college scholarships. He gained a Gilchrist scholarship at University College, London, in 1885, and studied there under Dr. Alex. B. W. Kennedy during the sessions of 1885-86 and 1886-7, spending a considerable portion of this time in experimental work in the laboratory at the college.

Prof. R. J. Durley.

At the conclusion of the course Mr. Durley took a very high position in all the college examinations in professional subjects, and in 1887 he passed the examination for the degree of Bachelor of Science of the University of London. On leaving University College he entered the works of Earles' Shipbuilding and Engineering Company, Ltd., of Hull, and served a term of four years apprenticeship as a mechanical engineer. During this time Mr. Durley spent some months working on board those ships of the Royal Navy then being engined by Earles' company in H. M. dockyards at Pembroke and Devenport. From 1890 to 1894 he remained in the service of the same firm, and was employed in designing marine and other machinery of varied types.

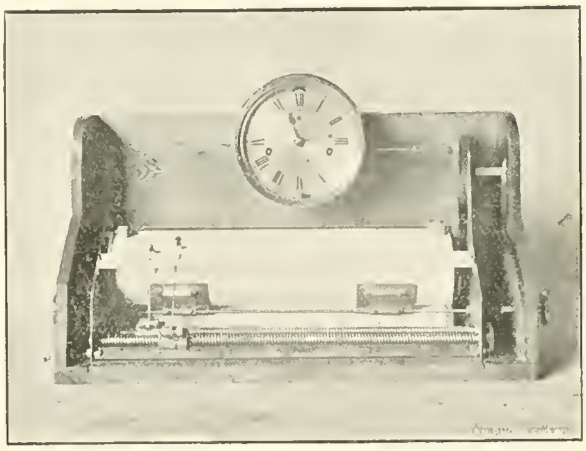
In 1894 Mr. Durley was appointed chief lecturer on mechanical engineering in the Hull Municipal Technical Schools, which were then being established, and he was responsible for the arrangement, organization and equipment of the workshops and laboratories of his department. In 1897, on accepting the appointment of assistant professor of mechanical engineering in McGill University, he came to Canada.

Prof. Durley is a Whitworth scholar and has on two occasions received Miller prizes for papers presented by him to the Institution of Civil Engineers (England), of which society he is an associate member. He is also an associate member of the Canadian Society of Civil Engineers, and has been a not infrequent contributor to the proceedings of that body. The work done for McGill University by Mr. Durley, as Dr. Nicolson's assistant, received academic recognition last year, when the degree of Master of Engineering was conferred upon him by the university.

THE MARTIN AUTOMATIC REGISTER.

The accompanying cut shows the Martin Automatic Register. It is the invention of Mr. F. W. Martin, station superintendent for the Hamilton Electric Light & Power Co., Hamilton, Ont. The register is for plotting the load curves of the different outputs of a station. The illustration shows two pens working over a scale of amperes. The pens use different colored inks, which makes them distinct and easy to trace. One can be plotting an incandescent while the other is plotting a power load. Besides being a reference for the office and to keep on file, it is a check on the switch-board attendant, as the charts move over a roller which is geared to a clock and keep the charts moving at the same rate as time; the pens resting on the chart record the load, and can be moved from left to right according to the variations. The charts are laid off in 15 minute readings unless otherwise wanted. The attendant cannot record the readings, as is sometimes done, by jotting down several readings from memory, and if the load does not change a key at one side is knocked down, and will mark the chart at that time, proving that he was on duty. The register carries a supply of charts which are on a roller under the large roller, and are either passed out at the back or rolled on to a third roller, if desired, and taken out when putting in a new supply of charts. The register can then be locked up by the foreman or superintendent, and the attendant can only get access to refill the pens, which will run about a week without refilling.

Mr. Martin has given the work of designing the new model to Mr. W. A. Turbayne, and when finished with the improvements, it will look very neat and attractive, fitted with a Seth Thomas eight-day clock, and finished in white nickel plate. Patents have been applied for in several countries.


The Martin Automatic Register.

The accompanying cut shows the one that was in operation at the Hamilton Electric Light & Power Co.'s station during the Canadian Electrical Association convention. Its usefulness was readily appreciated, and several orders were placed. As one well known station manager put it, "No station can afford to be without one."

Henry Sheldon, of Aylmer, Ont., is negotiating for the right to manufacture a motor carriage in Canada.

Forms Accompanying Paper on

CENTRAL STATION ACCOUNTING

From a Business Standpoint. By P. H. HART.*

SUBSIDIARY LEDGER.

Form No. I.

GENERAL CONSTRUCTION.

INCANDESCENT INSTALLATION

Date		Real Estate and Buildings.	Office Furniture and Fixtur's	Maps, Instruments and Drawing		House Connecti'ns	Placing Transformers.	Placing Meters.	Meters Located.	Transformers Located.	Interior Wiring.	Total.
1895 June												
July												
August												
Sept.												
Oct.												
Nov.												
Dec.												
1896 Jan.												
Feb.												
Mar.												
April												
May												
1896 June												
July												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												
1897 Jan.												
Feb.												
Mar.												
April												
May												
1897 June												
July												
Aug.												
Sept.												
Oct.												
Nov.												
Dec.												
1898 Jan.												
Feb.												
Mar.												
April												
May												

Original size of Form, 11 x 14 inches.

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* This paper was read at the recent convention of the Canadian Electrical Association, and was published in the last issue of the Electrical News.

Form No. 2.

Class of Account—GENERAL CONSTRUCTION.

Date.	ACCOUNT.	SUB-ACCOUNT.	Labor.	Material.	Total.
	Real Estate and Buildings				
	Office Furniture and Fixtures				
	Maps, Instruments and Drafting.				
	Incandescent Installations	House Connections.			
		Placing Transformers.			
		“ Meters.			
		Meters Located.			
		Transformers Located.			
		Interior Wiring.			
	Alternating Arc Installations	House Connections.			
		Placing Transformers.			
		“ Meters.			
		“ Lamps.			
		Meters Located.			
		Transformers Located.			
		Interior Wiring.			
		Lamps and Coils Located.			
	Arc Installations, City	Connections.			
		Lamps and Fixtures Located.			
		Placing Lamps and Fixtures.			
	Arc Installations, Commercial	House Connections.			
		Lamps and Fixtures Located.			
		Placing Lamps and Fixtures.			
	Series Inc. Installations, City	Lamps and Fixtures.			
		Connections.			
	Series Inc. Installations, Comm'l	Lamps and Fixtures.			
		Connections.			
	D.C. Motor Installations	House Connections.			
		Inside Connections.			
		Meters Located.			
		Placing Meter.			
	A.C. Motor Installations	House Connections.			
		Placing Transformers.			
		Transformers Located.			
		Placing Meters.			
		Meters Located.			
		Interior Wiring.			
		Placing Motors.			
	Lines and Poles	Incandescent.			
		Arc, City.			
		Arc, Commercial.			
		D. C. Motor.			
		A. C. Motor.			
		Alternating.			
	Subways and Conduits				
	Cables	Incandescent.			
		Arc, City.			
		Arc, Commercial.			
		Motor.			
	Tools	Incandescent.			
		Arc.			
		Motor.			
		Linemen's.			
		General.			
	Horses and Wagons				

Original Size of Form, 8 × 11 inches.

Form No. 3.

Class of Account—STATION CONSTRUCTION

Accounts for Each Station.

Date.	ACCOUNT.	SUB-ACCOUNT.	Labor.	Material.	Total.
	Real Estate and Buildings				
	Steam Plant	Boilers.			
		Piping.			
		Engines.			
		Pumps, Condensers and Heaters.			
		Shafting and Pulleys.			
		Belting.			
	Electric Plant	Incandescent Dynamos.			
		Incandescent Switchboard and Instruments.			
		Incandescent Switchboard Connections.			
		Arc Dynamos.			
		Arc Switchboard and Instruments.			
		Arc Switchboard Connections.			
		D. C. Motor Dynamos.			
		D. C. Motor Switchboard and Instruments.			
		D.C. Motor Switchboard Connections			
		Motors (in Station).			
	Station Tools	Steam Plant.			
		Electric Plant.			
		General.			
	Office Furniture and Fixtures.				
	Testing Equipment				
	Interior Wiring				

Original Size of Form, 8 × 11 inches.

Form No. 4.

Class of Account—STATION OPERATING

Accounts for Each Station.

ACCOUNT.	SUB-ACCOUNT.
Rent	
Taxes	
Insurance	
Steam Plant	Fuel. Cartage of Ashes. Boiler Compound. Water for Boilers. Boiler Room Wages. Engine " " Oil and Waste.
Electric Plant	Inc. Dynamo Tenders' Wages. Arc Dynamo Tenders' Wages. D. C. Motor Dynamo Tenders' Wages. Incand. Switchboard Tenders' Wages. Arc Switchb'd Tenders' Wages. D. C. Motor Switchboard Tenders' Wages. Inc. Dynamo Brushes. Arc Dynamo Brushes. D. C. Motor Dynamo Brushes. Incand. Commutator Segments. Arc Commutator Segments. D. C. Motor Commutator Segments. Arc Blower Wings.
Arc Lamps, City	Oil and Waste. Carbons. Trimming. Inspecting.
Arc Lamps, Commercial	Carbons. Trimming. Inspecting.
Alternating Arc Lamps	Inspecting. Trimming.
D. C. Motor	Inspecting. Testing.
A. C. Motor	Inspecting. Testing.
Incandescent	Inspecting. Testing.
Lamp Renewals	Incandescent. Series Inc. City. Series Inc. Commercial.
Incandescent Lamp Changes.	
Lines and Poles (to be subdivided where possible)	Inspecting. Testing.
Removing Lines and Poles	Incandescent. Arc, City. Arc, Commercial. Motor.
Removing Installations	Arc, Commercial. Arc, City. Incandescent. D. C. Motor. A. C. Motor. Alternating Arc. Series Inc., City. Series Inc., Commercial.
Fire Patrol	Arc, City. Arc, Commercial. Incandescent. Motor.
Testing (in Station)	Inc. Lamps. Meters. Alt. Arc Lamps. General.
Accidents	
General Expenses	Clerks. Stationary. General.

Original Size of Form, 8×1 inches.

Form No. 5.

Class of Account—STATION MAINTENANCE

Accounts for Each Station.

ACCOUNT.	SUB-ACCOUNT.
Real Estate and Buildings	
Steam Plant	Boilers. Piping. Engines. Pumps, Condensers and Heater Shafting and Pulleys. Belting.
Electric Plant	Arc Dynamos. Arc Switchboard and Instrument Arc Switchboard Connections. Arc Lamps in Station. Incandescent Dynamos. Incand. Switchboard and Instruments. Incandescent Switchboard Connections. Incandescent Lamps and Circuits. D.C. Motor Dynamos. D.C. Motor Switchboard and Instruments. D.C. Motor Switchboard Connections. Motors.
Lines and Poles	Incandescent. Arc, City. Arc, Commercial. D.C. Motor. A.C. Motor. General.
Installations Inc.	House Connections. Repairing Meters. Repairing Transformers. Replacing Transformers. Customers' Premises.
Inst. Alternating Arc	House Connections. Repairing Meters. Repairing Transformers. Customers' Premises. Lamps. Globes.
Inst. Series Inc. Commercial.	Lamp Fixtures. Lamp Connections.
Inst. Series Inc. City	Lamp Fixtures. Lamp Connections. Lamps.
Installations Arc City	Lamp Fixtures. Lamp Connections. Globes.
Inst. Arc Commercial	Lamps. Lamp Fixtures. Lamp Connections. Globes.
Installations D.C. Motor	House Connections. Customers' Premises. Repairing Meters.
Installations A.C. Motors	House Connections. Repairing Meters. Repairing Transformers. Customers' Premises. Motors.
Tools	Steam Plant. Electric Plant. Testing General.

Original Size of Form, 8×11 inches.

REQUISITION FORM

Form No. 6.

"Line Construction and Maintenance Dept." No..... .....

....189

Stores Dept. will please CHARGE to ....for order No...........

To be CHARGED

Blocks, Side
Bolts, Carriage, ⅜ x 4
" " ½ x 5
" " ½ x 7
" Machine, ⅜ x
" " " x
" " " x
" " ½ x
" " ½ x
" " ½ x
Brackets, Cross, 2 pin
" Flat, 2 pin
" Hook, with nut
" Leg
" 3 "
" Straight, 1 pin
" " 2 "
" " 1 " with nut
" " 2 " "
Braces for cross arms
Boxes, Junction
Cable
"
Cement, Roof
Charcoal
Cross arms, 2 pin
4 "
6 "
Cut outs, Film
Globes
Hanging Straps
Hangers, Iron Street
" Goose-neck
Hoods, Series Inc.
Insulators, Guy
Ordinary
D. P.
Porc.
Lamps, double arc, 2000 c.p.
" Single arc, 2000 c.p.
" Series 32 c.p., 9.6 amp.
" " 65 c.p., 9.6 amp.
Naphtha
Outriggers
" Plates
Pins, Oak
Poles, ft.
" "
" "
" "
" "
Rope, Manilla
Resin
Screws, Wood
" "
" "
Forward,

Forward,
Screws, Coach
" "
" Cap
Slings, rope
Solder
Spikes
Tape, Grimshaw
" Kerite
Transformers, Light No.
" " "
" " "
" " "
" " "
" " "
Turn Buckles
Tubing
Tripods
Washers, 5-16
" 7-16
" 9-16
" 13-16
Wire, Rubber Covered
" " "
" " "
" " "
" D. B. 4/0
" " 3/0
" " 2/0
" " 0
" " 1
" " 2
" " 4
" " 6
" " 8
" " 10
" " 12
" " 14
" " 16
" Cable
" "
" "
" Galv'd, 6
" " 9
" " 9 x 2 strand
" " 9 x 3 "
Received
Delivered by
D. B. Folio

Original Size of Form, 8 x 11 inches.

CREDIT

Form No. 6
No ....

"Line Construction and Maintenance Dept."

.. ..189

Stores Dept. will please CREDIT to ....for order No........ .

To be CREDITED

Blocks, Side
Bolts, Carriage, ⅜ x 4
" " ½ x 5
" " ½ x 7
" Machine, ⅜ x
" " " x
" " " x
" " ½ x
" " ½ x
" " ½ x
Brackets, Cross, 2 pin
" Flat, 2 pin
" Hook, with nut
" Leg
" 3 "
" Straight, 1 pin
" " 2 "
" " 1 " with nut
" " 2 " "
" Strap
Braces for crossarms
Boxes, Junction
Cable, Lead-concentric
"
"
"
Cement, Roof
Charcoal
Crossarms, 2 pin
" 6 "
" 10 "
Cut-outs, Film
Hanging Straps
Insulators, Glass, Small
" Ordinary
" D. P.
" Porc.
Naphtha
Outriggers
" Plates
Pins, Oak
Poles, ft.
" "
" "
" "
" "
Rope, Manillla
Resin
Screws, Wood
" "
" "
" Coach
" "
Screws, Coach
Solder
Spikes
Forward,

Forward,
Spikes
Tape, Grimshaw
" Kerite
" Okonite
Transformers, Light No.
" " "
" " "
" " "
" " "
" " "
" Straps
" Stays
" Tables
Tubing
Tripods
Washers, 5-16
" 7-16
" 9-16
" 13-16
Wire, Rubber Covered
" " "
" " "
" " "
" D. B. 4/0
" " 3/0
" " 2/0
" " 0
" " 1
" " 2
" " 4
" " 6
" " 8
" " 10
" " 12
" " 14
" " 16
" Cable
" "
" "
" Galv'd, 6
" " 9
" " 9 x 2 strand
" " 9 x 3 "
Received
Delivered by
D. B. Folio

Original Size of Form, 8 x 11 inches.

REQUISITION FORM.

Form No. 6.

Requisition No. **B** ....

Montreal 189

On General Manager's Order No. ....

	Class of Account.	Account.	Sub-Account.
For...			
Debit			
Credit			

Received by .... 189 .... *Foreman*

Delivered by .... *Supt.*

D. B. Folio .... *For use in* .... *Dept.*

Posted ....

Original size of Form, 8 x 10 inches.

Form No. 6.

CREDIT.

Requisition No. **C** ....

Montreal 189

On General Manager's Order No. ....

	Class of Account.	Account.	Sub-Account.
For......			
Credit			

Received by .... 189 .... *Foreman.*

Delivered by .... *Supt.*

D. B. Folio .... *For use in* .... *Dept.*

Posted ....

Original size of Form, 8 x 10 inches.

Customers' Record Book Form.

INCANDESCENT

For Month Ending June, 1899.

Cir. No.	Led. Folio.	NAME.	Date.	METER READ'G IN AMPERE HRS					Meter Rental.	Total.	Led. Folio.	Date.
				Present.	Consumed.							

Original size of Form, 23½ x 18 inches.

Form No. 8.

LIGHTING DEPARTMENT.

Ledger Folio.	Ck.	Customer.	Discount.		Totals.	Lighting		D. C. Motor.		
			Incand.	A C. Motor		Incand.	Com. Arc.	Current.	Rental.	Sales.

Original size of Form, 20 x 15 inches.

Note.—The Customer's Record Book Form and Form No. 8 should be read across the two pages.

Form No. 7.

Card........................

INCANDESCENT METER CARD.

Led. Fol............ Contract No ....Date..................................

Date of Connection ....Term..............Expires..................................

Name..

Address..

Business...

Remarks..

....

Meter No..Cap...Amperes

Gov. Cert. ....Per Cent. of Error..................................

Circuit No..Volts...

Lamps Installed.

Date.	Order	5 C.P.	8 C.P.	10 C.P.	16 C.P.	32 C.P.	C.P.	Total Eq to 16 C.P.

Original size of Form, 8 x 4½ inches.

Meter No........................ Voltage........................ Rate........................

Insp.	Date.	Reading.	Current Regist'd	Days	Remarks.

Original size of Form, 8 x 4½ inches. (Back of Incandescent Meter Card).

Manager's Order Form.

Name. .... Order No.........................

Address .... Date ....

....

This Order Authorizes and Directs that ....

....

....

....

....

....

....

Signed..General Manager

Return this Order as soon as completed, and report labor, material and expenses on following accounts.

Class of Accounts.	Account.	Sub-Account.	Station	No. of Circuit.	

To...

Report Here, Remarks, Etc.

....

....

....

....

....

....

Work Completed, Date ....

Signed By...

Original size of Form, 8 x 11 inches.

LIGHTING ACCOUNTS.

July, 1899.								August, 1899.							
Meter Read'g in Ampere Hrs.					Meter Rental.	Total.		Led. Folio.	Date.	Meter Read'g in Ampere Hrs				Meter Rental.	Total.
Present.	Consumed.									Present.	Consumed.				

CASH RECEIPTS.

Contract and Sales.			A. C. Motor.			Rental.			Miscellaneous.	Total.
Wiring.	Lamp Renewals.	Line Construction.	Current.	Rental.	Sales.	A.A. Lamps.	Transformers	Poles.		

AN INTERESTING LEGAL DECISION.

Mr. Justice Davidson recently gave his decision in the Superior Court at Montreal in an interesting case in which the Royal Electric Company were plaintiffs and Mr. Maurice E. Davis defendant. His judgment in full was as follows :

The Royal Electric Company vs. Maurice E. Davis, et al.—From the 20th of August, 1895, to the 20th April, 1898, plaintiffs supplied defendants with electric light for their premises situate on the corner of Dalhousie and Ottawa streets. Monthly accounts were rendered and paid up to the 25th of December, 1897. About the 1st of February following defendants were notified that a wrong principle had been followed in calculating the meter readings, and that the resulting under-charges amounted to $1,384.35, payment of which was asked for. The accounts for the current and following months were made on the altered basis of calculation. Defendants denied the existence of any error, and positively refused to reopen past settlements. To avoid litigation, however, and in view of the fact that but a short life remained to the contract when the dispute arose, they offered to acquiesce in plaintiff's pretensions as to the future. This was refused, and then came the present suit to recover $1,874.05. By way of defence, it is pleaded that the accounts, as closed up to the 25th of December, 1897, were in accordance with the contract, and that the tender of $423.40 made for the sake of peace and now renewed was more than sufficient to cover any lawful indebtedness. By the contract between the parties, defendants agreed to take and use for a term of not less than twelve months 175, or more, incandescent lamps, the installation of which was to be at their expense. The electric company was to furnish its own meter at a rental of 25 cents per month. Then appear covenants in the following words :

"Said lights to be supplied by meter, and we hereby agree to pay for the same at ¾ cent per ampere hour, the bill to be rendered monthly, which we agree to pay upon the 15th of each and every month, for the preceding month's lighting at the company's office in this city. * * * * * Should the meter cease to register through any defect in its manufacture or break in its mechanism, the Royal Electric Company reserves the right to charge for such period of non-registry at the same rate as that at which the meter was registering at the time of such break or interruption." The accounts rendered stated the last and current readings of the meter, and multiplied the difference by ¾ of a cent. The result, plus 25 cents for rent of meter, represented the monthly charge. I take as an example the invoice for the first month :—

For electric lighting from August 21, 1895, to September 25, 1895 :—

Present meter register	35,800
Previous meter register	33,650
Ampere hours registered	2,150
At ¾ cent per hour	$16.13
	.25
	$16.38

Now, according to plaintiff's pretensions, the ampere hours registered ought, in this and all subsequent accounts, to have been doubled before being multiplied by the price. The effect would have been to double all the monthly statements. I take as an example the first account which was tendered after the alleged mistake of calculation had been discovered :

For electric lighting from December 2, 1897, to January 25, 1898 :—

Present meter register	34,450
Previous meter register	25,610
Ampere hours registered	8,840
	2
	17,680
At ¾ cent per hour	$132.60
Rent of meter, one month at 25c. per month	.25
	$132.85

How plaintiffs justify this doubling up of the registered ampere hours calls for an explanation of a somewhat technical kind.

A transformer of 104 volts capacity transmitted a secondary current from plaintiff's main wires into the premises covered by the contract. Shallenberger meter within the building registered the ampere hours. Both transformer and meter had been in use during the previous occupancy of a firm of D. Ritchie & Co., among the partners in which were the present defendants. With but few exceptions, the company had in use 52 volt transformers. The company's inspectors, in their reports, made no mention of the voltage, if it were 52 ; they were expected to do so, if it were 104. Presumably from the facts that the transformer was not changed and that while in use by D. Ritchie & Co. two reports had been made of its voltage, the meter readings were returned to the office without special mention of the voltage. The chief clerk of the accounts department states that he, as a consequence, tendered statements on a 52 volt basis, and only in December, 1897, was it reported to the office that a 104 volt transformer was in use. Five or six weeks later the fact and pretended consequences were notified to the defendants. M. E. Davis gives the following account of the interview : "One of the Royal Electric Co.'s representatives came to our establishment one day and told us he had been making a mistake in our accounts for the last two years. I said, 'that is a strange thing ; I only remarked yesterday that I thought you were making mistakes, I have been complaining of exorbitant charges, the bills are large.' 'Well,' he replied, 'It is not that we have not been charging you enough.' 'Well,' I said, 'that is strange, you have been tendering bills monthly, and if I had known that I would not have had the lights ;' and they rendered another account for the following month, doubling up the price, which we returned, marked 'not correct.'"

Subsequently, as already stated, defendants, in the hope of avoiding a law suit, offered to acquiesce in the demand for the short time which the contract had still to run. But plaintiffs persisted in the belief that they were entitled to have all past accounts rectified and doubled in amount.

Upon what technical basis the claim rests, and what effect on figures a pressure of 104 volts instead of a supposed pressure of 52 volts produces, may as well be stated in the words of Mr. Gossler, plaintiff's electrical engineer and superintendent. They are as follows :—

"The reason is that if one lamp burned, or a sixteen candle power lamp at fifty volts permits a current to flow, for one hour of one ampere, a sixteen candle power lamp at one hundred volts allows it to flow but one-half ampere per hour, consequently the two lamps giving the same illuminating power will register on an ampere hour meter, in the case of fifty-volt lamps one ampere hour, in the case of a hundred-volt lamp, one-half ampere hour."

The statements do not represent theories, they are well-established scientific facts. But does this full acquiescence entitle plaintiffs to judgment. The answer has to be in the negative, and for a number of reasons.

The contract explicitly says that the lights were to be supplied by meter at ¾ of a cent per ampere hour, and if the meter were to break down, the charge was to be at the same rate at which the meter was registering at the time of such break or interruption.

Plaintiffs now want to base their calculations not on amperage alone, but on voltage also. They want to be paid for the product of quantity, which is called amperes, and of pressure, which is called "volts." The result gives the energy which is called "volts." If this were the true intent of the contract, why was not a constant ratio fixed between voltage and the amperage, as registered by the meter, which was of a standard kind, and in common, indeed, universal use, whatever the transformer might be? Or why not have provided for payment by volts instead of by amperes?

Mr. Lockart, chief electrician of the Montreal Street Railway, states his opinion in this effective way : "If a man came and said he would supply me current at any price per ampere hour, the voltage does not enter into it."

Plaintiff's interpretation of the contract, even if correct, is thus certainly open to legal and scientific controversy. Having for eighteen months not only acquiesced in, but given effect to the amperage meter readings without reference to voltage, they cannot now have specific performance imposed on defendants. To state a principle well known to the courts, relief will not be given to parties who sleep on their rights. Defendants' connection with the dissolved firm of D. Ritchie & Co. does not prejudice their position. Its contract was auxiliary to a local installations, and contains some words not present in the one under consideration, which may or may not be of distinct importance.

Had plaintiffs asserted their present position at the outset, it might have been open to defendants to dispute it more effectively than they can do now, or to have it torn up; or to certainly cancel at the end of twelve months ; or to handle their lights with greater economy of use. The action is dismissed with costs.

There is a movement on foot at Baddeck, C.B., looking to the installation of an electric light plant.

CANADIAN WATER POWER AND ITS ELECTRICAL PRODUCT IN RELATION TO THE UNDEVELOPED RESOURCES OF THE DOMINION.*

By Thos. C. Keefer, C.M.G.

Amongst the many partially developed resources of Canada, perhaps there is none more widespread or more far reaching in future results than her unsurpassed water power. The value of this has been enormously enhanced, first by the expansion of the wood pulp manufacture, and the introduction of electro-chemical and metallurgical industries for which this country possesses the raw material; and, more recently, by the revolution which has been brought about by success in transmitting the energy of water falls from remote and inconvenient positions to those where the work is to be done.

Electrical transmission brings the power to the work, and when the prime mover is water, we have the cheapest power, and perhaps nearest approach to perpetual motion which it is possible to obtain—one which is always "on tap," and, like gravity, maintained without cost and applied without delay.

While water power was at first the only substitute for the windmill in new countries, and its economy as well as superiority has always been recognized, several causes have contributed to limit its more general application. Before the invention of the turbine in the first half of the present century, heads exceeding about seventy feet could not be utilized on account of the comparative weakness and excessive cost of wheels of large diameter. In these days of structural steel, and "Ferris" wheels, this difficulty could be overcome; but, with the turbine the conditions are reversed, the higher the head the less the size and cost of wheels, so that the most valuable water powers were the most cheaply utilized in this respect.

A previous check to the greater extension of water power was given in the latter part of the last century by James Watt's discovery of the steam engine, which by bringing the power to the work, to the city, and to the mine, revolutionized industrial conditions.

A still greater revolution has recently occurred which brings water power to the front again, by its amalgamation with electricity, whereby its economical power is transferred to the work, over many miles of distance upon a single wire.

Within the last ten years high voltage electricity has been firmly established with annually increasing power of extension, and this has brought Canada into the first rank of economical power producing countries. Water is thus represented by a power to which it can give birth, but which is superior to its own, in that, whereever transplanted, it can do nearly all the parent power could do, as well as give light, heat and greater speed; moreover, it has given rise to industries only possible with abundant cheap electricity. What is more important to us is that such industries are those for which Canada possesses the raw material, but which, without water power, she could not engage in.

There are important industries in which we have for some time utilized water power, for which electricity is not indispensable, but which equally require large amounts of cheap power, and are capable of indefinite extension; but while these may not need the intense electric current necessary for electro-chemical industries, they will find electrical transmission of inestimable value in many situations; while, for lighting and heating purposes, water power is invaluable to all.

Heretofore we have cut our spruce into deals and exported it to Europe, and more recently into pulp wood and exported that to the United States, but, manufactured by our water power into paper, the raw material would yield this country ten times the value it is now exported for.

The extension of railways, combined with electrical transmission, will promote the local manufacture of such wood products (including all valuable hardwood) as can bear transportation, thus giving the largest amount of local employment, as well as tonnage to the railway, and delivering us from the position of "hewers of wood" for other countries.

ELECTRICITY.

In order to present more fully the recently enhanced value of our Canadian water power, some reference is necessary to certain properties of electricity, the power which has happily been described as "the most romantic form of energy" by Wm. Henry Preece, C.B.F.R.S., in his recent address as president of the Institution of Civil Engineers.

Inasmuch as the cost of production of electrical energy depends upon continuity of output, water power must be the ideal one for this purpose, at least until some cheaper power is discovered. In some places where steam is now used for electric light, other industries have been added to secure the more continuous use of the power in daylight hours.

The only quality in which any deficiency has been exhibited by electricity is for lighthouse purposes, a lesser power of penetration in fogs, in which respect it is inferior to oil or gas; but even this has in the present year been more than compensated for by the successful application of "wireless telegraphy," by which, in any weather, communication between the ship and the shore can be established. The shores of the St. Lawrence from the Atlantic to the Lakes are lined with water power which can be used to light, in fair, or protect, in foul weather, the passing vessel, to ring the bell or blow the horn.

When water is applied for light and power purposes, its economy is always the important factor, but it is chiefly to its value for electro-chemical industries that Canada will look to reap the greatest benefits, because in these it is not merely a question of competition of power producers, but one in which intense electricity has the monopoly, and in the case of some of them, as in the production of aluminium, calcium carbide, carborundum, etc., their existence depends upon ample supplies of an intense electric current, for the generation of which abundant and cheap water power is indispensable.

Touching electro metallurgical processes, Mr. Preece says: "Every electrolyte requires a certain voltage to overcome the affinity between its atoms, and then the mass decomposed, per minute or per hour, depends solely upon the current passing. The process is a cheap one and has become general. Three electrical h.p., continuously applied, deposits 10 lbs. of pure copper every hour, from copper sulphates, at the cost of one penny. All the copper used for telegraphy is thus obtained. Zinc in a very pure form is extracted, electrolytically, from chloride of zinc produced from zinc blende, in large quantities. Caustic soda and chlorine are produced by similar means from common salt. The passage of electricity through certain gases is accompanied by their dissociation, and by the generation of intense heat. Hence the arc furnace. Aluminium is thus obtained from cryolite and bauxite. Phosphate is also separated from apatite and other mineral phosphates. Calcium carbide, obtained in the same way, is becoming an important industry. Electrical energy can be generated on a coal field where coal, of good carolific value, is raised at a cost of three shillings per ton, cheaper than by a water fall, even at Niagara."

Eastern and Western Canadian coal fields are separated by thousands of miles, but water power is abundant throughout nearly all this coalless region. Our western coal fields are vast and their market at present limited. If coal can be raised cheaply enough and the raw material for the work be discovered in the neighborhood, they may give rise to electro-chemical and electro metallurgical industries without the intervention of water power.

The commercial production of calcic carbide (acetylene gas), by electrolysis, is the discovery of Mr. T. L. Wilson (a grandson of the late Hon. J. M. Wilson, of Saltfleet, Ont.), who has established works on the water powers of the Welland Canal and has shipped this product all round the world.

The electric production, commercially, of caustic soda and chlorine is under the patent of Mr. Ernest A. Leseur, son of the Secretary of the General Post-Office Department, Ottawa. This manufacture is now being carried on by a Boston company at a New England water power.

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* Abstract from Presidential Address read before the Royal Society of Canada, May 23rd, 1899.

MINING.

There is another field nearly as widespread as our water power in which electricity is destined to play a most important role, and this is mining, which is now spreading over the Dominion with the same rapidity as the utilization of our forests for pulp and paper purposes. Over this area minerals have been discovered and in many cases tested and successfully worked, and from recent results we appear to be on the threshold of remarkable developments in this direction, especially as so small a portion of so great an area has been prospected sufficiently for mining purposes.

For power purposes alone, electricity is invaluable in mines, and its multifarious uses (as enumerated by Mr. Preece) are "for moving trams and for working hoists; it lights up and ventilates the galleries, and, by pumping, keeps them free from water. It operates the drills, picks, stamps, crushers, compressors and all kinds of machinery. The modern type of induction motor, having neither brushes nor sliding contacts, is free from sparks and free from dust. Electric energy is safe, clean, convenient, cheap, and produces neither refuse nor side products." The Canadian mining districts are well supplied with water power, and all the wonderful effects of electricity are available for us upon a larger and more economical scale than elsewhere. In connection with this abundance of water power, and from the fact that a large proportion is at present situated remote from present railways and present settlements, the question of profitable limit of electrical transmission is most important—if, indeed, it be now possible to put a limit on anything connected with electricity, with or without the aid of a wire. If, as reported, Lord Kelvin has placed the profitable limit at 300 miles, this is sufficient to utilize the greater part of the water power upon the two watersheds north of the St. Lawrence river.

Professor Elihu Thomson says, "Up to the present time it was practicable to transmit high pressure currents a distance of 83 miles, using a pressure of 50,000 volts. If a voltage higher than that were used, the electricity would escape from the wires into the air in the form of small luminous blue flames." As showing how far we are yet behind nature, Prof. Thomson says the estimated voltage from a lightning discharge ranges from twenty to fifty million volts.

Wherever the raw material for electro-chemical, electro-metallurgical, or other industries, affords sufficient inducement, and the water power is at hand, the forest will be penetrated much more rapidly than heretofore, and settlements advanced in new directions. What can be done in this direction is best illustrated by the development of a single industry in the wilds of Minnesota north of Lake Superior, and adjoining Canadian territory. Over four hundred miles of standard gauge railways have been built, through what was a trackless wilderness in 1885, to reach iron ore beds, the ore from which is shipped to Lake Erie and thence again railroaded 200 miles into Pennsylvania. This one business has, in mines, railways, docks and fleets of steamers, required an investment of $250,000,000, and has led to as low a rate, by water, as 1 cent per bushel for wheat between Chicago and Buffalo, and 20 cents per ton for coal from Lake Erie to Duluth, nearly 1,000 miles. One-half of the charcoal iron, and more than half of the pig iron made in the United States, is smelted from Lake Superior ore.

ELECTRIC RAILWAYS.

The substitution of electricity for steam as the motive power for railways on many roads is regarded as inevitable sooner or later. It has already taken place as regards suburban railways, notably in the case of the Charlevoix road and Hull and Aylmer railway, where water is doing the work which has heretofore been done by coal. The chief obstacles to an early change on the larger roads are the hundreds of millions invested in locomotives, and the very large outlay required to equip existing steam roads with the electric system. The principal inducement would be the passenger service, owing to the increased speed possible, it being confidently stated that, with electricity, a speed considerably over one hundred miles per hour could be attained. Moreover, there would be entire abolition of the poisonous smoke which drops upon the Pullman in preference to any coach ahead of it.

While the conversion of trunk lines would be attended with a cost which is for the present prohibitory, this objection does not apply to new lines, which may be worked independently, or in connection with electric ones. When the time arrives for such railways, water power will have a field of usefulness of which we can at present form little conception. Water wheels and wires would displace the coal docks, the coal-laden vessels, the huge coal yards, and the trains required for distributing their contents over hundreds of miles of lines.

An interior line connecting Lake St. John, on the Saguenay, with Lake Temiscamingue, on the Ottawa, which could ultimately be extended, via Missanabei, Nepigon and Lac Seul to the Saskatchewan, would be a colonization road, removed from the frontier—one which could be worked possibly altogether by water power, and would open a virgin tract in which electro-chemical and electro-metallurgical industries might arise, as well as those connected with the products of the forests and the mine.

SPARKS.

The city of Winnipeg, Man., wants tenders by August 12th for the supply of twenty miles of wire for a fire alarm system.

The Hamilton Brass Works, of Hamilton, Ont., have followed the example of a number of other manufacturers in Hamilton and installed in their factory a 30 h.p. S. K. C. motor, which is operated by current from the Cataract Power Company's lines.

The Nelson Electric Tramway Co. have just closed a contract with the West Kootenay Power & Light Co. for the supply of power for the new street railway at Nelson, B. C. Mr. C. H. Hall has been appointed engineer-in-charge of the construction work.

The Dominion Coal Co., Cape Breton, N.S., are adopting electricity for the lighting of their mines, and have placed an order with the Canadian General Electric Co. for one of their standard 30 kilowatt direct connected generators, together with switchboards and wiring.

Prominent Montreal men have made application for a charter for the Wire & Cable Company. The capital is to be $500,000 and the factory will be located in Montreal. Messrs C. F. Sise, L.B. McFarlane and C. P. Sclater, of the Bell Telephone Co., are among the promoters.

The corporation of Fort William are setting up in their new power and pumping station a new 180 k.w. S. K. C. machine, with switchboard, etc. They are also largely increasing their incandescent lighting. When completed this will be one of the most up-to-date and modern electric light and water power systems in the Dominion.

The corporation of Dundalk, a short time ago, passed a by-law to raise $9,000 for the purchase of an electric lighting plant. The contract for the engines and boilers was awarded to E. Leonard & Sons, of London, and the contract for the electrical equipment, consisting of a 30 k.w. S. K. C. generator, with switchboard, transformers, etc., to the Royal Electric Company, of Montreal. The plant is to be in operation by Sept. 15th.

The town council of Arnprior, Ont., will likely enter into a contract with Robert Anderson, of Ottawa, for lighting the streets for five years. Mr. Anderson's proposition is to furnish twenty lamps of 1,200 candle power at the price of $42 per year, and to light the town hall with 16 candle power incandescent lamps at the cost of 1 cent per hour, 50 per cent. discount. The council have decided to take this step in view of their inability to obtain from the Arnprior Electric Light Company what was considered a reasonable price.

A most complete electric light plant has been installed by the British Columbia Marine Railway Company's ways at Esquimalt, B.C. This enables the company to dock or launch ships just as easily at night as in the day, and makes it possible to carry on work on vessels both night and day, causing a considerable saving to the owners. The plant, which was installed by Messrs G. C. Hinton & Co., consists of a 120 16-candle power light dynamo. Fifty lights have been placed on each side of the cradle, every other lamp being attached to a long insulated cord so that it can be placed wherever required. Five arc lights have been placed on the wharf and mounted on a carriage, so that they can be moved about the yard as a 6,000 candle power search-light. The light from this can be thrown across the harbor to guide ships to the railway, or when ships are on and work is proceeding at night, used to give additional light to the workmen. The company have awarded the contract to Messrs. Hinton & Co. to install a duplicate plant at the railway they are constructing at Vancouver.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

THE ANNUAL CONVENTION.

Arrangements are nearing completion for the annual convention of the above association, to be held in Berlin on Tuesday, Wednesday and Thursday, August 15th, 16th and 17th. The members of the local association are working earnestly to make the convention a success. Besides the usual business, papers will be presented by Mr. E. J. Phillip, of Toronto, and others, and on Thursday evening a banquet will be held at the Walper House, at which it is expected there will be a large number of guests.

From Mr. G. C. Mooring, of Toronto, who is acting executive-secretary, we learn that the reports from the various associations indicate that there will be a satisfactory attendance. The Toronto contingent, which will comprise probably fifteen members, is expected to leave at 8:30 a. m. on Tuesday. Delegates should buy a single ticket, and obtain from the secretary at Berlin, Mr. W. Oelschlager, a certificate stating that they were in attendance at the convention. This will entitle them to return fare at a reduced rate. Following is the programme :

OFFICIAL PROGRAMME.

TUESDAY, AUGUST 15TH.—11 a. m.—Reception of Delegates ; Mayor's Address of Welcome. 2 p. m.—Meeting of Committees.

WEDNESDAY, AUG. 16TH.—9 to 12 a. m.—General Business. 2 p. m.—Reading of Papers and Discussions. Evening.—Open Air Concert by B. M. S. Band in Victoria Park.

THURSDAY, AUGUST 17TH.—9 a. m.—Business of convention continued. 2 p. m.—Election of Officers and other Business. 9 p. m.—Banquet House at Walper to the Officers and Delegates.

TORONTO NO. 1.

At the annual meeting of Toronto No. 1, held on Wednesday, June 21st, the following were elected officers for the year : President, H. E. Terry ; vice-president, J. Huggett ; recording secretary, W. J. Webb ; financial secretary, A. E. Bourne ; treasurer, S. Thompson (acc.); conductor, J. Bannan ; doorkeeper, W. Butler ; trustees, W. Lewis, A. E. Edkins and W. J. Webb ; delegates to convention, A. E. Edkins, C. Moseley, J. W. Marr, W. J. Webb and J. G. Bain.

TORONTO NO. 18.

Toronto No. 18 have elected the following officers : President, J. M. Dixon, acclamation ; vice-president, T. Graham ; recording secretary, Jos. T. Smart, acclamation ; financial secretary, J. J. Richardson, acclamation ; treasurer, P. Trowern ; conductor, R. Riley ; door-keeper, James Hutchins ; trustees, A. W. Vancer, Joseph Hughes and F. W. Fanner ; delegates, Messrs. Dixon, Richardson and Trowern. A few questions relating to engine compounding, boiler construction and heating surface, and the comparative merits of fuel, were asked and satisfactorily answered.

HAMILTON NO. 2.

Hamilton association last month elected officers as follows : T. Chubb, president ; W. Sculthrope, vice-president ; J. Ironside, recording secretary ; J. Carroll, financial secretary ; W. Collins, conductor ; T. Carter, doorkeeper ; trustees, P. Stott, R. Pettigrew, R. Mackie ; auditors, G. Mackie, R. Pettigrew, W. Stevens ; delegates to convention, G. Mackie, J. Ironside.

Mr. Ernest S. Harrison has established business at 191 Thistle street, Winnipeg, Man., and will in future represent the Western Electric Company, of Chicago. He will give attention to electrical construction and repair work of all kinds, and will make a specialty of armature winding and motor repairs. He will also carry a complete stock of supplies.

Just as we go to press it is learned that the contract for the Ragged Rapid transmission scheme for the town of Orillia is likely to be awarded to Mr. P. H. Patriarche, of the Electric Maintenance & Construction Co., of Toronto. After a delay of several months, the contract was thrown up by the Central Construction Company, of Buffalo, the original contractors.

Mr. Ephrem Valiquette, of Montreal, was the winner of the gold medal at the Industrial and Mechanical course at the Monument National. Mr. Valiquette is provincial boiler inspector, president of the Engineers' and Mechanical Mutual Benefit Association, and also a member of the Canadian Association of Stationary Engineers. He is now foreman for Lymburner & Matthews, mechanical engineers, of Montreal.

ENGINEERING NOTES.

As to the causes of the round corners on the admission line of the diagram from the steam cylinder of his air compressor, a writer says that the diagram shows that the release opens late ; the compression is late, and therefore the admission is late, so there is no lead, thereby making the round corners referred to. All the movements are too late ; to overcome this, advance the sheave.

In a recent paper by Mr. T. Messenger before the Northeast Coast Institute of Engineers and Shipbuilders, a method of strengthing steam pipes was mentioned. It consisted in applying a series of clips (in two halves) cottered together, says the Practical Engineer. In a 12 inch pipe, with 100 pounds steam pressure, they have been pitched 6 inches apart. They have a sectional area ⅜ square inch (2 inches wide by 3-16 inch thick). One advantage that they undoubtedly offer is the restriction of a failure, as usually a rupture produces an opening extending from flange to flange. They can be easily applied to the joints or branch junctions, strengthening the necessarily weak places in a range of piping. We should think that there should be a large field for their use where brazed copper pipes are unavoidable.

Why should the pressure fluctuate more at the end of a long steam main than at the boilers ? is the question which is troubling one of the subscribers of Power. The answer given is that if there were no flow through the pipe the pressure at the far end would be the same as that at the boiler, and would vary as the pressure at the boiler varied. Steam will not flow from one point to another, however, without a difference in pressure, and the greater the rate of flow the greater the difference of pressure required. If the pressure at the boiler, then, were absolutely constant, there would still be a variation at the far end of the main dependent upon the rate of flow, and if the boiler pressure varied we should have at the end of the pipe a variation which would be the combined effect of the changing boiler pressure and the fluctuation due to the varying rate of flow.

FEED WATER.—Treatment of feed water by engineers has not, as a rule, met with any great success, as a number of experiences in this line that have been shown up will testify, but there a few tests that every one having charge of boilers should be familar with. The presence of hard or soft water is easily detected by dropping a few drops of alcohol that has dissolved all that it can possibly hold of good soft soap. The water will turn milky white if it is hard and remain clear if soft. Add to the water from five to ten drops of oxalate of ammonia in a test tube. If carbonate of lime be present the water will in a short time present a clouded or milky appearance, and in a few hours a precipitate will be found at the bottom of the tube. Take some of the feed water and add a few drops of nitrate of baryta or barium chloride. If sulphate of lime or sulphuric acid is present it wil be shown by a milky appearance, and by the formation of a white precipitate. If decomposed animal matter is the cause of all the trouble it will be shown by adding a drop of premaganate of potash, which will color the water a bright violet rose when first added. If decomposed organic matter is present the color changes to a dull yellow ; if present in large quantities, however, the color will in time disappear. If, upon adding a few drops of solution of prussiate of potash, a blue color is produced directly or after some time, it shows that iron is held in solution.

TO COVER IRON PULLEYS WITH LEATHER.—With a given tension of belt nearly three times as much power can be transmitted by a leather-covered pulley as with a smooth iron surface. It is a comparatively easy matter to cement leather to the face of a pulley so that it will stay for an indefinite length of time—in fact, until the latter is worn out or is forcibly torn from the pulley. It is an easy matter to make such a cement joint as it would be if cementing to wood or other porous substance. Any good glue can be used if suitably prepared and carefully spread on the iron surface. For such purposes a given amount of glue should be covered with an equal weight of water, aad the whole let stand for twenty-four hours until the water is completely absorbed by the glue. The mass should then be heated in a water bath until the glue is melted. This makes a concentrated glue solution. This is to be spread on the surface of the pulley after the leather has been suitably prepared. A strong solution of tannic acid should be used for moistening the leather before it is applied to the glued surface. The solution should be applied warm. The surface of the pulley should be roughened by cross-filing, or the use of acid before the glue is applied, and the glue should be warm when the application is made. The leather used for covering pulleys may be pieces of old belting or split leather. The size of the pulley can be increased considerably by the use of the leather covering.

ELECTRIC RAILWAY DEPARTMENT.

MECHANICAL TRACTION BY ELECTRICITY.*

By Granville C. Cunningham, M.I.C.E.

In the installation of mechanical traction by electricity on tramway systems, the point to be considered is how this form of traction compares in cost of construction and working with that it displaces, and what are the conditions that make for a high or low cost of working. It will doubtless be admitted that unless such form of traction were financially superior to other forms it would not be adopted; but it will be useful to inquire wherein this particular superiority lies, as this indicates the direction in which the skill and resource of the engineer should chiefly be turned. The cost of constructing and equipping an electric tramway system is very much greater than the cost of a horse system. The receipts per car-mile may not be much greater, and with the largely increased mileage run may possibly be even less; therefore, unless the expenses per car-mile of the electric system are very much less than the expenses of the horse system, whence can be obtained the large additional net revenue required to pay interest and sinking fund on the greatly increased capital invested? It is accordingly to this lowering of the cost of electrical working that the attention of the engineer should be chiefly directed, and the best results in this respect can be obtained only by care in construction.

In the first place, on what item in working cost may a saving be looked for?

In the matter of wages of men on the car no saving can be effected; two men would be needed on the electric as on the horse car, and the electric employees may even be expected to require higher wages. Tbe maintenance of car-body painting, repairs, etc.- would be practically the same in either case; the maintenance of the electric equipment of the car is an addition to any expense of the horse system; so also is the overhead wire and feeder system; the maintenance of the track would be greater for the electric system, including therein the bonding. In all thesee items the cost in the total would be greater for the electric than for the horse system. There would be some advantage to the electric system in being able to run at a higher speed, thus distributing the wages of motormen and conductors over a larger mileage in a day and reducing the amount of that item per car-mile. But this is not a large amount and would not compensate for the increase in the other items mentioned.

The only item remaining to be considered is the power used in the service, and it in in this item also that the saving can be effected. For this reason the power house on an electric system is the point to which the intelligence and skill of the engineer should be mainly devoted. It is upon this that the financial success of the undertaking depends. If it is carelessly constructed, with engines, boilers and appliances that do not insure a low cost of working, then it is certain that but a small profit—and perhaps no profit at all—will be realized. It is certain that no great financial success will be secured. Everything that will reduce the cost of producing the electric current should be sought out and applied in the construction of the power house

The cost of horse traction—and by this is meant the cost of horse-keep, wages of grooms, shoeing, veterinary expenses, but exclusive of drivers' wages—may be taken as varying from 3½d. per car-mile in an easily-worked town such as Glasgow, to 5d. per car-mile in a hilly and more difficult town, such as Liverpool. This is the cost of horse traction arrived at from the working of fairly large systems showing 7,000,000 car-miles annually in Glasgow and over 4,000,000 in Liverpool. The cost of electric power for traction on the overhead trolley wire system should, with enonomical engines, boilers and heat-saving appliances, be under ½d. per car mile for an easily-worked level town, and for a more hilly town with steep gradients slightly over ½d. per car-mile. The cost nere meant is the cost of all wages, fuel, water, oil, etc., in the power house, together with the cost of maintenance, repairs and up-keep of the plant. The cars driven by this power are those weighing about 6½ tons when empty and capable of seating 26 passengers inside. In order to insure this low cost of working every care must be taken in the power house. In choosing its site it should be placed close to a plentiful supply of water, where all that is requisite for condensing purposes may be had at a nominal charge, or merely for the cost of pumping. A river, canal, pond or the sea would afford what is needed. It should be conveniently situated for the supply of coal from railway line, canal or wharf, so as to save the charges of handling fuel. One shilling per ton saved in cartage would amount to a very considerable sum in a year in a large traction station.

But, needless to say, the most important matter is the type of engines, boilers and heat-savers to be used. The writer favors low-speed (70 revolutions) compound condensing engines, such as are built by numerous English firms, boilers of the Lancashire or Galloway type, with Green's economizers. A plant of this character was constructed and worked under the writer's charge on the Montreal Electric Street Railway, with the result that the cost of producing current was a little under one farthing per kilowatt-hour, and the cost per car-mile less than half-penny in the open months of the year, when coal could be obtained for 9s. per ton. The consumption of coal was 3.48 lbs. per kilowatt-hour, or 2.60 lbs. per e.h.p.-hour, and this was maintained during the months of working. The average for a whole year was only 2-75 lbs. per ehp.-hour. It is not pretended that this is a phenomenally low rate of consumption. On board many of the large ocean-going steamers as low as 1.50 lbs. of coal per h.p.-hour has been reached with triple expansion engines; but the writer believes that few electrical power-houses have been able to show better results than those mentioned. Nor is the result to be attributed to a very large output; precisely similar results can be obtained by using similar appliances on a smaller scale. In the Montreal house there were six 800-h.p. engines, and the daily output of current averaged 43,000 units. But the author has recently obtained similar results with a small cable plant on the Birmingham cable system. In 1897 this plant consisted of a pair of single cylinder engines running at 53 revolutions of 287 maximum h.p., wlth Galloway boilers, and no special heat-saving appliances. It was necessary to increase the engine-power to meet increased traffic. The author put in a pair of superposed compound condensing engines of 400 h.p. running at same speed as before, and obtained condensing water from a well in conjunction witb a tank and cooling tower. The result was that the consumption of fuel was reduced from about 325 tons per month, or 8.9 lbs. per car-mile, to 6.5 lbs. per car-mile; and the introduction of Green's economizers has further reduced the consumption to 4.7 lbs. per car-mile, or to about 3 lbs. per h.p. hour. On the Birmingham small cable system, the saving does not amount in money to a large sum, but on a great electric system running, say, 7,000,000 car-miles in the year, 4 lbs. of coal saved per car-mile, at 9s. per ton, amounts to £5,625 per annum; and it is this consideration that gives emphasis to the plea for an economical power-house plant.

To return to the previous argument. Note what a large saving is effected when a cost of ½d. per car-mile for power is substituted for 5d.; on a car-mileage of 7,000,000 it means no less a sum than £131,250 per annum! and indicates the source whence the increase of net earnings may be obtained to pay for the heavy cost of electrical installation. The whole cost of working a large electric system, including working charges of all kinds, should be under 5d. per car-mile; but this can only be obtained with a carefully constructed power-house, where the works-cost of the current is cut down to a minimum.

The limits to which this note had to be confined prevent the introduction of any more elaborate figures or statistics than those given; but enough has been said to indicate that, in the writer's judgment, it is to the power-house that the chief attention should be directed in order to ensure the financial success of an electric system. Other parts of the system claim attention, but it is on this that success or failure mainly turns. More money can be lost on the one item of power than would pay all the other working charges, and whether the high potential system with transformers or the multiple unit system be adopted, the successful working ultimately depends upon having engines and boilers that will do their work with a low consumption of fuel.

It is believed that the council of the town of Woodstock, Ont., will accept the proposition made by Messrs. Iekes & Armstrong, of Harrisburg, Pa., for the construction of an electric railway in that town.

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*Read at the Engineering Conference, Section VII, of the Institution of Civil Engineers, London, Eng., June 8, 1899.

SPARKS.

Robert Surtees, C. E., of Ottawa, has estimated the cost of an electric light plant for the village of Shawville, Que., at $4,000.

The Canada Atlantic Railway Co. will this fall commence the erection of additional car works at Ottawa, to be operated by electricity.

The Hull Electric Co., at a meeting held last month, elected directors as follows: Alex Fraser, David McLaren, W. J. Conroy J. B. Fraser, R. H. Conroy and T. Viau.

Figures are being taken on developing the power of the Current river at Port Arthur. It is said that the work will cost about $5,000 and will include four turbines of 75 h.p. each.

Messrs. Corey & Campbell, of Bedford, Que., have given the United Electric Company, of Toronto, an order for one of their 1,000 light inductor alternators for street and commercial lighting.

Two buildings are being erected at Waverly, N. S., for the company which has been formed to manufacture electrical apparatus, fuses, etc. There will be five buildings in all, and the industry will employ a large number of hands.

The Dominion Electrical Works, Limited, has been formed at Halifax, N.S., for the purpose of manufacturing electrical apparatus and supplies. The capital stock is placed at $30,000. B. F. Pearson and Harold Covert, of Halifax, are among the promoters.

The new steamer "Argyle," plying between Kingston and Ontario Lake ports, is one of the palace steamers of Lake Ontario, its fittings being of the finest. It is lighted throughout by electricity and also has a search-light. The entire electrical plant was installed by the Royal Electric Co., of Montreal.

The Eastern Townships Electric Company, of North Hatley, Que., has been granted incorporation, with a capital stock of $300,000, to generate electricity and construct necessary works for the purpose. Andrew J. Gordon, of North Hatley, and F. E. Lovell, of Coaticook, Que., are members of the company.

Mr. Moise Paquin, of Maskinonge, one of the promoters of La Societe Industrielle du Comte de Maskinonge, is negotiating with American capitalists for the sale of St. Ursule Falls, on Maskinonge river, in the province of Quebec. It is said that these falls are equal to the Shawenegan Falls for power purposes. They have a decline of 180 feet and no less than seven cascades, at the foot of each of which industrial establishments could be erected on solid rock foundation.

Ottawa capitalists are said to be considering a scheme for the harnessing of the entire water power of the Chaudiere Falls. The idea is to build a large canal from near the head of the falls down through a suitable channel, the water to be directed into this by means of a dam, and a large power house to be built at the lower end of the artificial waterway. The electrical power thus developed would be employed for the running of saw mills, carbide factories, electric light plants, etc. It has been calculated that the falls would produce over 160,000 h.p.

The city council of St. Thomas, Ont., have renewed the contract for street lighting with the St. Thomas Gas Co. The company are to supply the same number of lamps as at present in use, all night, on a ten years' contract, at 25 cents per lamp per night, or 26 cents per lamp per night for moonlight schedule, with the provision that when the number of lamps reach 100 or more the price is to be reduced one cent per lamp per night. Incandescent lights for public buildings are to be supplied at 58-100 of a cent per lamp per hour.

It is announced that the company controlling the water power at Shawenegan Falls, Que., has induced the Pittsburg Reduction company to establish works there for the manufacture of aluminum. Aluminum, as is known, is extracted from a particular clay. Chome is to be found in quantities in Canada, and this, with a mixture of 94 per cent. of aluminum, will produce a metal said to be as strong as steel. If such works are established in Canada, it is probable that aluminum wire will be used to a greater extent for the transmission of electricity.

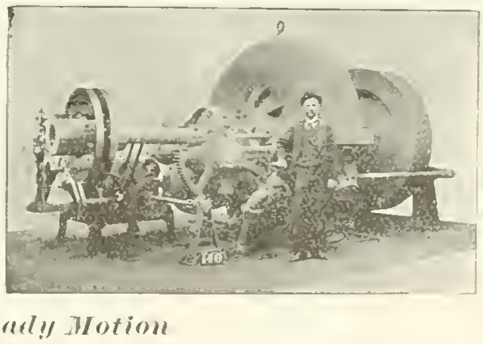
The City of Georgetown, British Guiana, has recently introduced the electric light. The arc lamps became centres of attraction to cockles, a species of small beetle, which swarm in myriads along the coast and river shores at the commencement of the Guiana rainy season, and each lamp was speedily filled to the brim. The front ranks of the insects then came in contact with the current, which set their bodies on fire. The immediate result was that the lamps were rendered useless for illuminating purposes, and vast clouds of intolerably noxious fumes emanated from them and floated into the neighbouring houses. the inmates of which were driven nearly frantic.

The Electric Light Co. which recently secured a contract for lighting the town of Merritton, and which have about 400 incandescent lamps installed in houses, and 20 enclosed arc lamps on the streets, have began operations with their own water power and apparatus. They have, however, made an arrangement now by which the St. Catharines Electric Light Co. are to furnish them current from their station, which is about four miles distant. The plant of the St. Catharines Electric Light & Power Co. is being considerably changed and enlarged. One side of their new 200 k.w. S.K.C. generator will supply the town of Merritton and that district lying south of their power house, and the other phase that portion of the city of St. Catharines north of their power house. During the hours of day-light this polyphase machine will be used for supplying power to the different industries in and about St. Catharines.

Rules for automobiles have been adopted in France to secure safety of passengers, pedestrians and other vehicles. These require that the operating mechanism, steering gear and brakes meet the approval of an inspection board, and are, in brief, that: Each vehicle must bear the maker's name, the type of the machine and the number of vehicle in that type, also the name and address of the owner. No one shall drive the automobile who is not the holder of a certificate of capacity from the Prefect of the department in which he resides. The driver of an automobile must always have the regulator of speed well in hand. In case of narrow or crowded thoroughfares, the speed must be reduced to a walking pace, and in no case must it exceed 18½ miles in the open country or 12½ miles an hour while passing houses. Racing is allowed, providing authorization is obtained from the Prefect and the mayors are notified. In racing speed of 18½ miles an hour may be exceeded in the open country, but in passing houses the maximum of 12½ miles must not be exceeded. The approach of an automobile must be signaled by means of a horn. Each automobile must be provided with two side lights, one white and the other green.

Victor Turbines

OPERATING DYNAMOS



That there are more **Victor Turbines** in use supplying power for electric generators than any other, is due to the many points of superiority possessed by this Turbine.

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High Speed, Close Regulation, Great Capacity
High Efficiency, Perfect Cylinder Gate, Steady Motion

RECENT PLANTS INSTALLED:—Lachine Rapids Hydraulic & Land Co., Montreal, Que., 12,000 h.p.; Chambly Manufacturing Co., Montreal, Que., 20,000 h.p.; West Kootenay Power & Light Co., Rossland, B.C., 3,000 h.p.; Dolgeville Electric Light & Power Co., Dolgeville, N.Y.; Honk Falls Power Co., Ellenville, N.Y.; Hudson River Power Transmission Co., Mechanicsville, N.Y.; Cataract Power Co., Hamilton, Ont.

CORRESPONDENCE SOLICITED.

The Stilwell-Bierce & Smith-Vaile Co. = *DAYTON, OHIO, U. S. A.*

TRADE NOTES.

The Canadian General Electric Company are installing a 50 horse power three-phase induction motor at St. Elmo mine, Rossland, B.C., for the James Cooper Mfg. Co.

The McLaughlin Carriage Company, of Oshawa, have placed an order with the United Electric Company, Ltd., for a 25 k.w. direct connected generator and engine, with complete accessories for operating same.

The Canadian General Electric Co. have recently sold the Wm. Hamilton Mfg. Co., Vancouver, B.C., one of their standard compound wound multipolar generators for direct connection to Pelton water wheel.

The large 176 barrel mill of the Dowling Milling Company, at Edmonton, N.W.T., is being furnished throughout by the Goldie & McCulloch Company, Ltd., Galt, Ont. This includes engine and boiler, as well as mill machinery.

The corporation of Bothwell, Ont., have placed an order with the Canadian General Electric Company for all the additional material required for extending their plant recently installed by the Canadian General Electric Company.

The United Electric Company, Ltd., Toronto, have closed a contract with the Kingston Hosiery Company for a 30 h.p. direct connected generator, switchboard, engine, and the installation of lights throughout their mills at Kingston, Ont.

The Goldie & McCulloch Co., Ltd., Galt, Ont., have just completed the placement of two large cross compound Wheelock engines at Bond Lake, in the power house of the Metropolitan Street Railway Company. The engines are from 400 to 450 h.p. each.

The Robb Engineering Company, of Amherst, N. S., has recently received the following orders from British Columbia: City of Kamloops, a 150 h.p., and the Hastings Exploration Syndicate a 60 h.p. Mumford improved boiler; Hugh C. Baker, Rossland, a 15 h.p., and Robertson & Hackett, Vancouver, a 50 h.p. Robb-Armstrong engine.

Messrs. Steinhoff & Gordon, of Wallaceburg, who are erecting a stave and heading mill at Tweed, Ont., have decided to add an electric lighting plant to light the town ot Tweed. The order for the electrical apparatus, consisting of a 40 k.w. S. K. C. generator, with switchboard and complement of transformers, has been given to the Royal Electric Company, of Montreal.

SPARKS.

The city council of Montreal is again taking steps to compel manufacturers to install smoke consuming apparatus.

The Standard Chemical Co. are installing a new electric plant at their works at Deseronto, Ont. The Canadian General Electric Company are supplying the apparatus.

The Montreal Street Railway Company have placed an order with the Canadian General Electric Company for 10 additional 2 motor equipments of their standard G. E. 1000 type.

Messrs. W. D. McNair, of New York, and J.S. Clark, of Ayr, are promoting an electric railway from Ayr to Berlin. They have made application to the council of North Dumfries for right of way.

A 40 h.p. S. K. C. induction motor has been installed by the Cataract Power Company in the works of the Hamilton Tack Co., which will add another smokeless chimney to the "Electric City."

Senator Proctor, of Vermont, who is interested in the proposed pulp and electrical works at Grand Falls, N.B., states that surveys have been made and that Montreal engineers are now at work on plans of mills, dams, canals etc.

The United Electric Company, Toronto, have received an order from the Kootenay Supply & Construction Company, of Nelson, B. C., for a 100 k.w. generator direct connected to Pelton water wheel, to operate under 360 feet of water head.

The ratepayers of Niagara Falls, Ont., have voted in favor of purchasing the plant of the Niagara Falls Electric Co., at the price of $71,000. It is proposed to utilize the power during the day time for operating the works of the Ontario Silver Plate Co.

The Dominion Government is calling for tenders, up to August 18th, for the supply of 330,000 pounds, or 165 tons of galvanized iron telegraph wire; also for delivery with above of 10,000 pounds of soft annealed galvanized iron tie wire. Particulars may be obtained from E. F. E. Roy, secretary Public Works Department.

The city of Hull Que., recently invited tenders for an electric light plant, but as yet the council has not awarded any contracts, on account of the pending law suit between the Ottawa and Hull electric companies. The city solicitor gives it as his opinion that the city has a right to establish its own plant, notwithstanding the privileges given to the electric companies.

The Gowans, Kent Co., of Toronto, have given a contract to the United Electric Company, Ltd., Toronto, to equip their new wholesale warehouses with a complete electric plant, consisting of 30 k.w. generator, direct connected to high speed engine, also boiler, switchboard, three elevator motors, and the installation of lights and fixtures throughout their five-story building and basement.

The recent introduction of series enclosed arc lighting from alternating current systems by the Canadian General Electric Company is meeting with the approval of all central station managers. The Sherbrooke Gas & Electric Co. was the first to adopt this system in Canada, and will shortly have their new installation completed. The Halifax Tramway Co. have just placed an order with the Canadian General Electric Company for 100 of these lamps, with transformers.

The city council of Winnipeg, Man., recently accepted the following tenders for supplies and apparatus in connection with the electric light plant: Electrical supplies, Canadian General Electric Co., $140.22; one 100 h.p. high speed engine, E. Leonard & Sons, London, $1,246; leather belting, Sadler & Haworth, Toronto, $4.90 per lineal foot for 42 inches in width, and $1.45 for 14 inches; shafting, pulleys, etc., Dodge Manufacturing Co., Toronto, $1,700. For wiring the city hall the tender of H. Rose was accepted, at $318.45.

On June 14th last judgment was given at Ottawa by Mr. Justice Burbidge in the patent case of the General Engineering Co., of Toronto, vs. The Dominion Cotton Mills Co. and the American Stoker Co. The plaintiffs claimed that the defendants had infringed their patent for improvements in furnaces, etc., by making and erecting for use, at the works of the Dominion Cotton Mills Co., furnaces with a system of fuel supply the same as that covered by the plaintiffs patent. Judge Burbidge upheld the validity of the patent and gave judgment for plaintiffs.

The contracts are said to have been let for the electrical machinery and water wheels for the calcium carbide works at Ottawa. The entire plant will cost about $225,000. The electrical apparatus will be supplied by the Canadian General Electric Company, of Toronto, and will consist of two single phase generators, directly connected to horizontal turbines, without gearing. There will also be two 400 h.p. 225 volt direct current machines for operating motors for crushing, mixing, etc. The switchboards will be grey marble, containing all the necessary instruments for controlling the heavy currents incidental to the operating of such large generating units. The current will be conveyed from the generators at a potential of 2,300 volts to the transformers, where it will be reduced to 75 volts for the furnaces.

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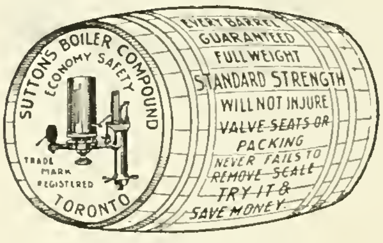

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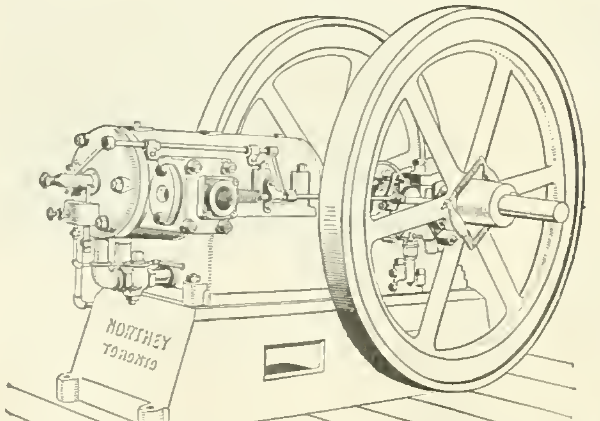

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Supplies a smooth running, continuous, easily-controlled form of power, essential to the operating of electrical machinery. It is extremely simple in construction aud so easily run that it requires no attention for hours at a time. Its handiness and convenience make it specially useful in the case of Isolated Plants, such as that in a gentleman's residence or small town.

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CANADIAN
ELECTRICAL NEWS
AND
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VOL. IX. OCTOBER, 1899 NO. 10.

THE KOOTENAY-ROSSLAND POWER TRANSMISSION.

DESCRIPTION OF THE SUB-STATION AT ROSSLAND—APPLICATION OF THE POWER FOR MINING PURPOSES.

IN the ELECTRICAL NEWS of September, 1898, there were published illustrations and a description of the water power, generating station and pole line of the West Kootenay Power and Light Company, of Rossland, B.C. By the plant of this company power is transmitted from Bonnington Falls, on the Kootenay river, to Rossland, a distance of about thirty miles. Below will be found a very complete description of the sub-station at Rossland, and of some of the installations at the mines, for which we are indebted to the Journal of Electricity :

FIG. 1.—THE SUB-STATION AT ROSSLAND.

The transmission line enters the sub-station at Rossland through portholes lined with eight-inch terra cotta piping similar to those provided at the power house. As one enters the door of the sub-station the standard General Electric lightning arresters used are placed on a marble board in a corner at the left. The choke coils used are an innovation, in that each consists of a core twelve inches or so in length turned in the center of a stick of kiln dried and well filled timber about five inches square by from six to eight feet long. About this core insulated wire is wound until the space is filled, so that the choke coil thus formed resembles an exaggerated form of spark coil with its terminals carried out to the respective ends of the timber on which it is wound, these timber ends being strapped to the top of high tension insulators through which the choke coil is cut into the line. Such choke coils are placed in every line, not only at the sub-station but at every power service. Originally the Rossland sub-station contained but six 250-kilowatt step-down transformers, although six others, each of equal capacity, have since been installed, together with a new 1,500-kilowatt generator. The line wires are carried to the high tension switchboard at the rear of the station on high tension insulators supported by framings that hang from the roof girders, and the usual facilities are provided to afford safety and celerity in the handling of both the high and low tension sides of the transformers. These latter are of the same type and size as those installed at the power house, with the exception that the primaries take either 9,600 or 16,600 volts, according to whether connected in delta or Y, while the secondaries deliver 2,200 volts in three-phase current, which is the potential used on all the lighting and power distributing circuits in and about Rossland.

Here may be explained the very meritorious method which the electrical engineer of the West Kootenay Power Company, has devised for applying the air blast to the transformers at the power house and at the Rossland sub-station. As in the power house, the blast is supplied by three sixty-inch blowers, each driven by belting from a two horse power 100-volt induction motor. Instead of carrying this air blast to the transformers through small air ducts as is usually done, the engineer of the Kootenay plant has provided subways large enough for a man to enter and move about in. The manner in which the blowers supply air to these subways is shown in the end elevation of the sub-station, while the subways themselves, as is shown in the side elevation, extend in line with and directly under each row of step-down transformers. The idea of this arrangement will be understood when it is stated that each week the transformers are cut out of service one by one and the air ducts in them are each and every one examined and cleaned by a man who enters the subway in order that he may have access to the lower end of the air ducts in the transformer. His

FIG. 2.—INTERIOR OF SUB-STATION AT ROSSLAND.

work in cleaning the transformers is facilitated by the use of compressed air, which is obtained in both the power house and the sub-station from a single drill compressor driven by an induction motor. It is safe to say that so long as this method of transformer examination and cleaning is faithfully carried out the Kootenay transmission will never lose a transformer from the choking of its air ducts. Slides for regulating the amount of air to be delivered to each transformer are provided, and of course the subway is always air tight, and the man who cleans the transformers is under the increased atmospheric pressure of the air blast while at his work.

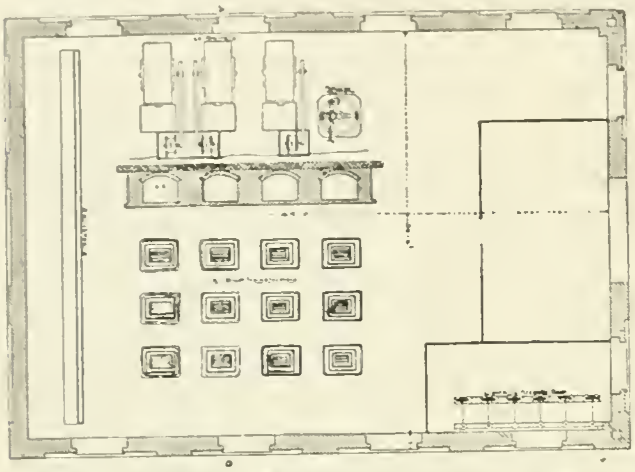


Fig. 3.—Floor Plan of Sub-Station at Rossland.

The photograph showing the interior of sub-station was taken shortly after the plant started operations, and since then important additions have been made. The distributing switchboard at the right in the rear has had new panels added to it to accommodate other circuits. The third blower has been added, and immediately in front of it, as shown in the floor plan of the sub-station in Fig. 3, has been placed the induction regulator by means of which the potential of the outgoing lighting service is controlled by the sub-station attendant independent of the power house. This is a new device of the General Electric Company, bearing the designation "type I. R. T., class 4-20-60, form A." It is wound for seventy amperes per phase at 2,200 volts, and has a range of 220 volts in either direction. It is described as consisting of an induction motor with a vertical shaft, which is connected through bevel and worm gearing to the shaft of a pilot motor placed on top of the case so that the rotor of the induction regulator may be made to turn a given arc in either direction, and in so turning raises or lowers the electromotive force in the primary mains passing through the stator windings as desired. The pilot motor is manipulated from a single double-pole, double-throw reversing switch placed on the switchboard; and this motor too is an induction motor. All details of this novel regulator, together with those of the limiting switch placed thereon, are given in Fig. 11. At present this regulator is used only on the lighting circuits, nor is its use contemplated on the power service.

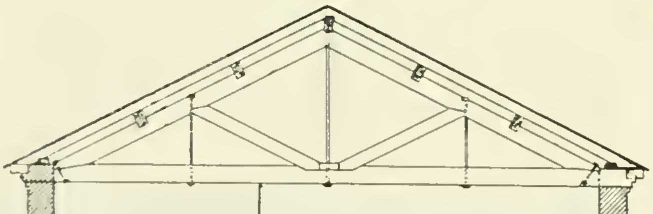


Fig. 4.—End Elevation of Sub-Station at Rossland.

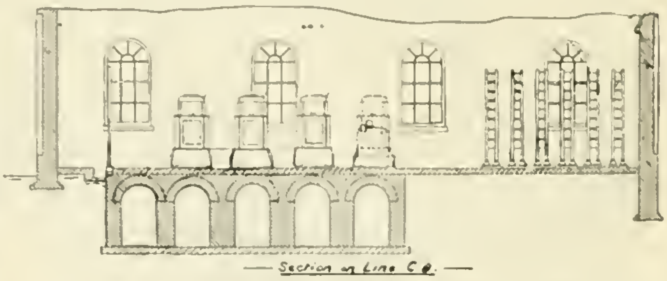


Fig. 5.—Side Elevation of Sub-Station at Rossland.

All the electric lighting in Rossland, in both arc and incandescent services, is rendered from alternating circuits, and indeed the only use to which direct currents are put in the Kootenay plant is for the excitation of generators and synchronous motors. The electric lighting load reaches a maximum of nearly 400 horse power. Enclosed alternating arc lamps are used exclusively, and these are burned from the 110-volt commercial circuits. The ultimate distribution is on the Edison three-wire system through the use of type H transformers, taking either 1,400 or 2,080 volts on the primary and delivering 230 volts across the outsides of three-wire service. The utmost care has been exercised in preserving the balance on the three-wire distribution circuits as well as in balancing the primaries of the commercial transformers on the three-wire, three-phase, 2,200-volt circuits, and this balancing has been carried out so well that it has never been observed that the phases of the 2,200-volt circuits have been more than 10 amperes out of balance.

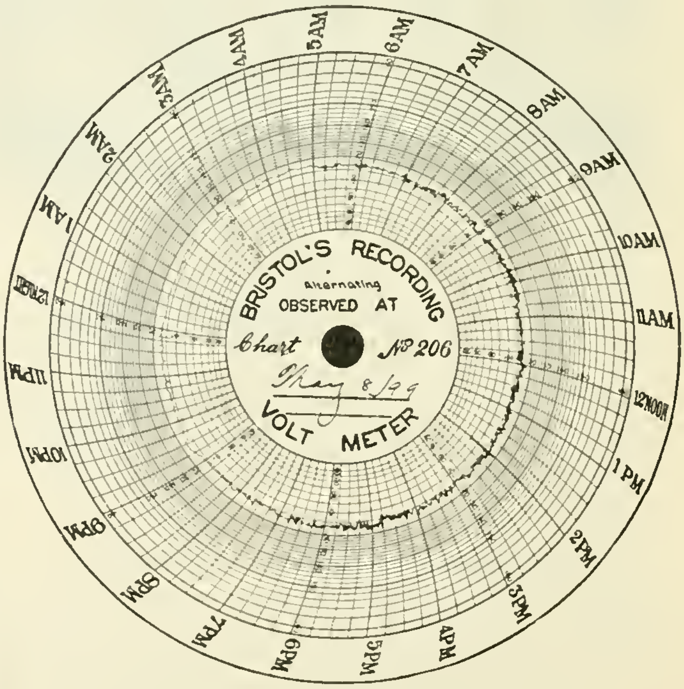


Fig. 6.—Typical Chart of Voltage Regulation.

As stated heretofore, the principal interest in the Kootenay-Rossland transmission centers in its application of electric power for mining and milling purposes, the most notable installations being in the properties of the War Eagle Mining and Development Company, the British Columbia Bullion Extracting Company, the British American Corporation, and the Gertrude, Big Three and Iron Mask mines. These six properties alone consume about seventeen hundred horse power in the operation of hoists, compressors, crushers, conveyors, ventilating blowers and in electrolytic work. The bulk of this power is delivered by induction motors, for, as a general rule, synchronous motors have been applied only to the driving of compressors.

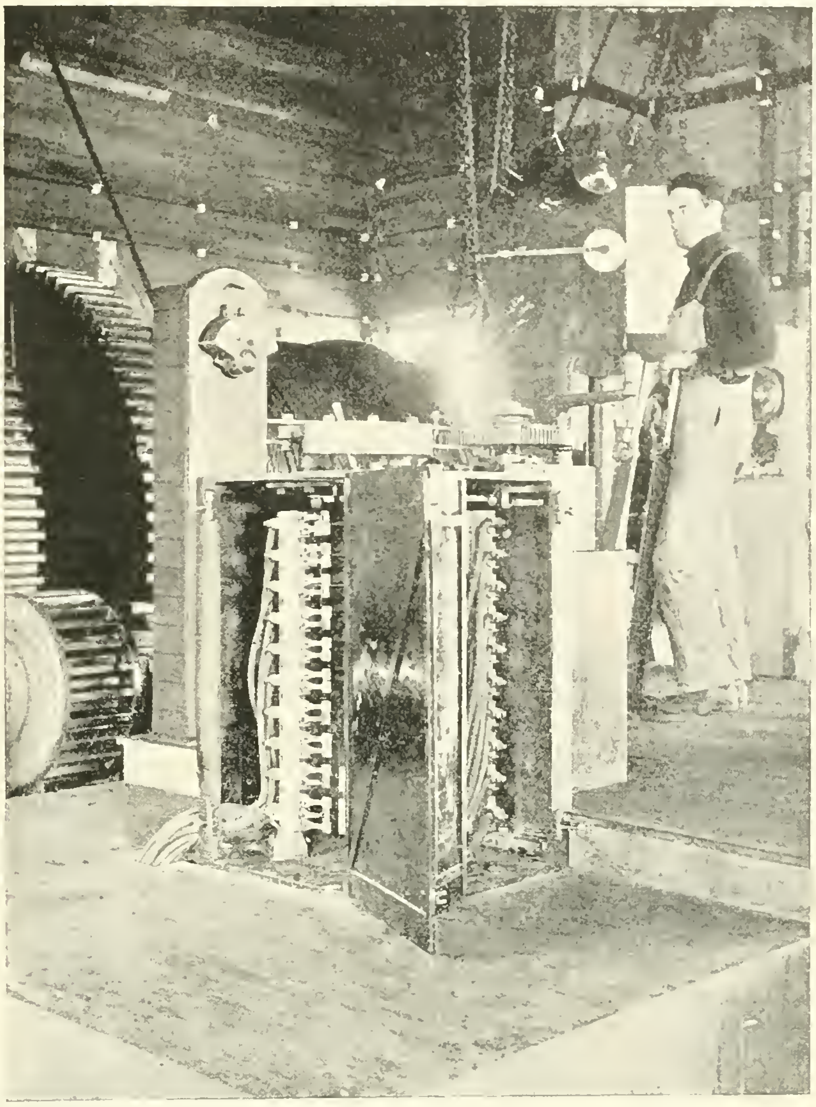


Fig. 7.—View of Controller for Induction Motor for War Eagle Mine.

Fig. 7 gives a general view of the controller of the War Eagle hoist, which will be seen to be a standard General Electric induction motor. It is a three-phase equipment operated at 2,300 volts, has twenty-four poles and delivers three hundred horsepower at three hundred revolutions per minute. Its technical designation is, therefore, "I 24-300-300 form A." The rotor shaft is geared to a Ledgerwood type double drum hoist through double reduction gearing, having a ratio of reduction of 300 to 40. The War Eagle shaft is at present down a little beyond the 600-foot level and the maximum load raised amounts to eight tons, including the load, cage and rope, the speed being 720 feet per minute for this load.

Interest, of course, centres in the method of speed control, each technical detail of which is fully shown in the accompanying illustrations. Secondary control is used exclusively; that is, no effort whatever is made to control the primary current, while the secondary current, or that induced in the rotor circuit, is varied by the introduction of external resistance. The controller proper, shown in Fig. 7, is a duplex one, inasmuch as the movement of the controller handle manipulates both the primary and secondary circuits of the motor, the former for making, breaking and reversing, and the latter for the control of the variable external resistance. The controller on the high tension or stator side operates in a bath of mineral oil. The secondary windings are led to three collector rings placed on the shaft with the rotor, and upon these rings bear carbon brushes which cover about 90 degrees of the surface of the rings, this being a necessary procedure because of the heavy ampereage to be taken off. The maximum secondary electromotive force obtained is in the neighborhood of seventy volts. From the rotor brushes the current is carried to the low tension side of the controller, through which resistance may be cut in or out of the rotor windings in ten steps. The resistance consists of cast iron grids arranged upon a large slate resistance board as shown in Figs. 8 and 9. With the maximum load of eight tons gross at a speed of 720 feet per minute the current reaches a maximum of 110 amperes per phase, dropping back to 90 amperes as the load decreases by reason of the cage nearing the surface. With a load of men the maximum current is 70 amperes per phase.

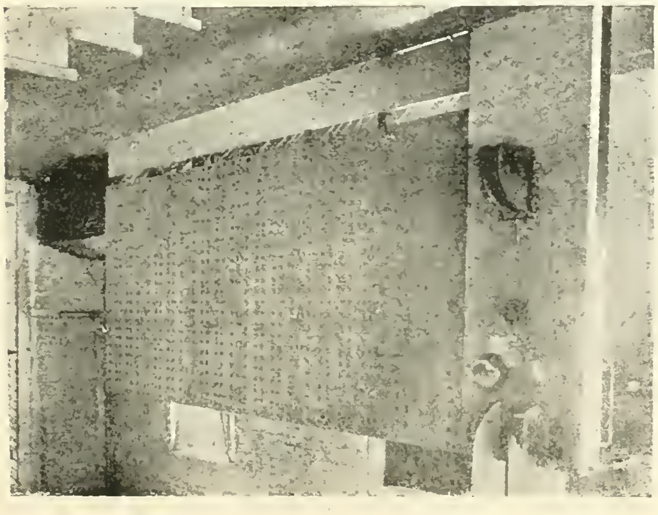
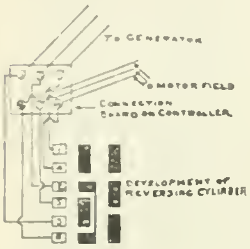


Fig. 8.—Front View of External Resistance Board.

The principle under which variable speed is attained in the operation of this induction motor is found in the fact that while in the synchronous motor exact synchronism between the motor and the generator must always be maintained, yet the induction motor is so constituted as to be nearly independent of any magnetic slippage that may exist between its stator and rotor. When under full speed the motor is practically in synchronism with the generator, but with the generator speed constant a variable speed in the motor is best attained by the introduction of methods that will provide variable slippage as desired, for the greater the slippage the slower will be the speed of the rotor. The equipment at the War Eagle hoist is so controlled that the speed of the motor may be varied from forty revolutions or less per minute to its full speed of three hundred revolutions.

It will be seen that the high and low tension controllers are geared together, this being done in such a manner that both are actuated at proper intervals by the manipulation of a single controller handle. The only function of the electrical equipment is that of hoisting, for as the cages are balanced one against the other, it is the rule that power is applied for either direction of rotation. Braking is done through the application of band brakes by means of the hand levers shown in the illustration.


To Generator
Motor Field
Connection Board on Controller
Development of Reversing Cylinder

The subjoined diagram of circuit connections shows the development of the reversing cylinder as applied to the high tension controller. The head board of this controller has six terminal lugs, those numbered 1, 2 and 3 being for the service leads, while those numbered 4, 5 and 6 are carried to the motor. The controller applies the full line potential of 2,300 volts to the stator, and it serves not only as a make and break switch but also as a pole changer for reversing. The short circuiting of terminals 1 to 4, 2 to 6, and 5 to 3, causes a given direction of rotation, while the short circuiting of terminals 1 to 4, 2 to 5, and 3 to 6 causes an opposite direction of rotation, all as shown in the attached circuit diagram. Mineral seal or any high grade transformer oil may be used for the bath for this high tension controller, which gives perfect satisfaction in operation.

The connections of the circuits by means of which external resistance may be cut in and out of circuit with the rotor windings through the low tension controller are outlined in Fig. 10, and in Fig. 13 is given the assembly diagram of the stationary cast iron resistance as mounted on the slate resistance board shown in front and back views in Figs. 8 and 9. It must be understood that the terminals at the bottom of the slate panels appearing in the upper portion of Fig. 10 are the same as those shown at the bottom of Fig. 13. The resistance strips shown so clearly in Fig. 9 consist of cast iron grids, each in three waves, having a sectional area of about $\frac{1}{8}$ by $\frac{5}{8}$ inches and which have a running length of about sixty inches. These grids stand out from the board about 14 inches and they are in 23 vertical rows by 18 horizontal ones, and while the average cross section is as given, it varies slightly above and below that figure according to the ampereage carried.

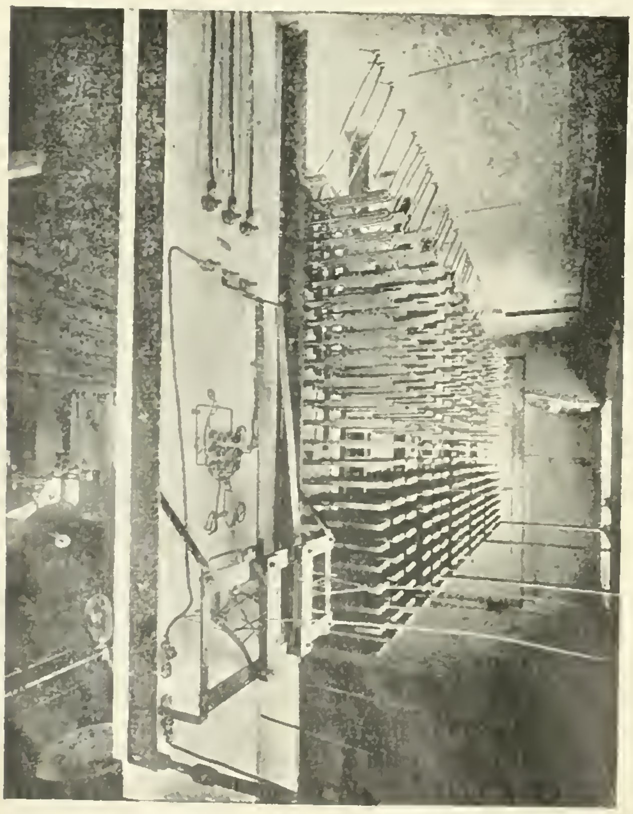


Fig. 9.—Back View of External Resistance Board.

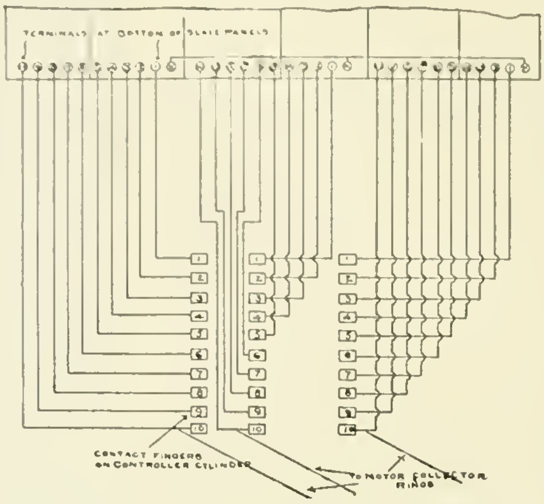

Terminals at Bottom of Slate Panels
1
2
3
4
5
6
7
8
9
10
Contact Fingers on Controller Cylinder
To Motor Collector Rings

Fig. 10.—Connections of Induction Hoist Motor and Controller.

Reverting to the scheme of low tension controller and resistance switchboard connections outlined in Fig. 10, the leads from the slip rings on the shaft of the motor are carried to three sets of contact plates placed on the controller cylinder in ordinary arrangement, and upon these contact plates play the contact fingers which carry current successively to the resistance. Three posts are erected in the controller, each of which carries a set of ten contact fingers, and two of the sets are shown in Fig. 7. As stated, the maximum potential broken by the low tension controller is about seventy volts and the sparking is inconsequential.

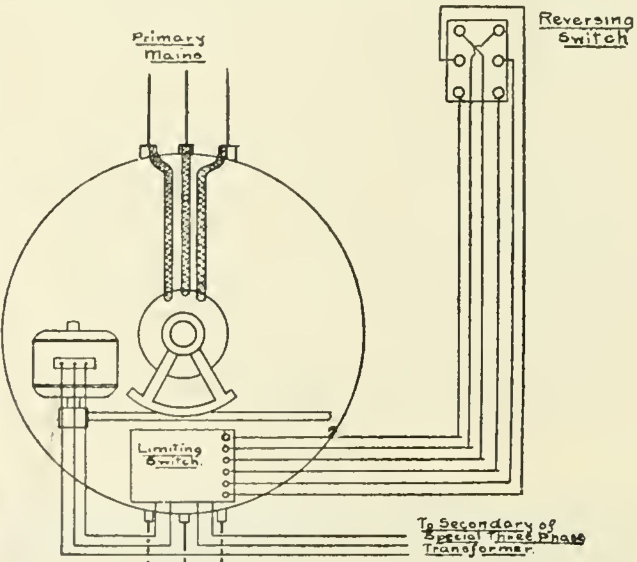


Fig. 11.—Connections of Induction Regulator.

One who is interested could spend hours in watching the operation of this hoist. It is easily handled by one man, who finds himself with much less to do than has the motorman on an electric railway. In fact, the operation of the War Eagle hoist finds greater resemblance to street railway practice than one would imagine. The controller is manipulated with the same ease and celerity that attends the handling of a street railway controller, and it is more simple than the modern street railway controller in one regard, and that is the fact that reversal is accomplished by the moving of the controller handle in a reverse direction rather than in the throwing of a special lever. At times when men are on the cage the hoist is "kicked" along by the momentary application of power to the motor, which enables it to be run at much slower speed even than that possible with the controller on the first notch. At other times, in hoisting ore, a dead load of five tons of which is almost always carried, the motor will be brought up to speed in a very few seconds and this without any abnornal inrush of current, for, as stated, during the writer's observations of the operation of the equipment under all conditions of service, the motor intake did not exceed 110 amperes per phase. The motor has an efficiency of 92 per cent. and a full load power factor of 88 per cent., while at the slowest speed the power factor may drop to possibly between sixty and seventy per cent., but of this last statement no direct data is available at present. Current for the operation of the entire War Eagle equipment is sold by contract, i.e., on flat rates.

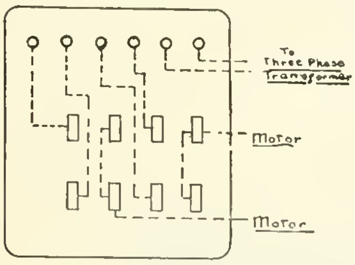


FIG. 12.—CONNECTIONS OF LIMITING SWITCH.

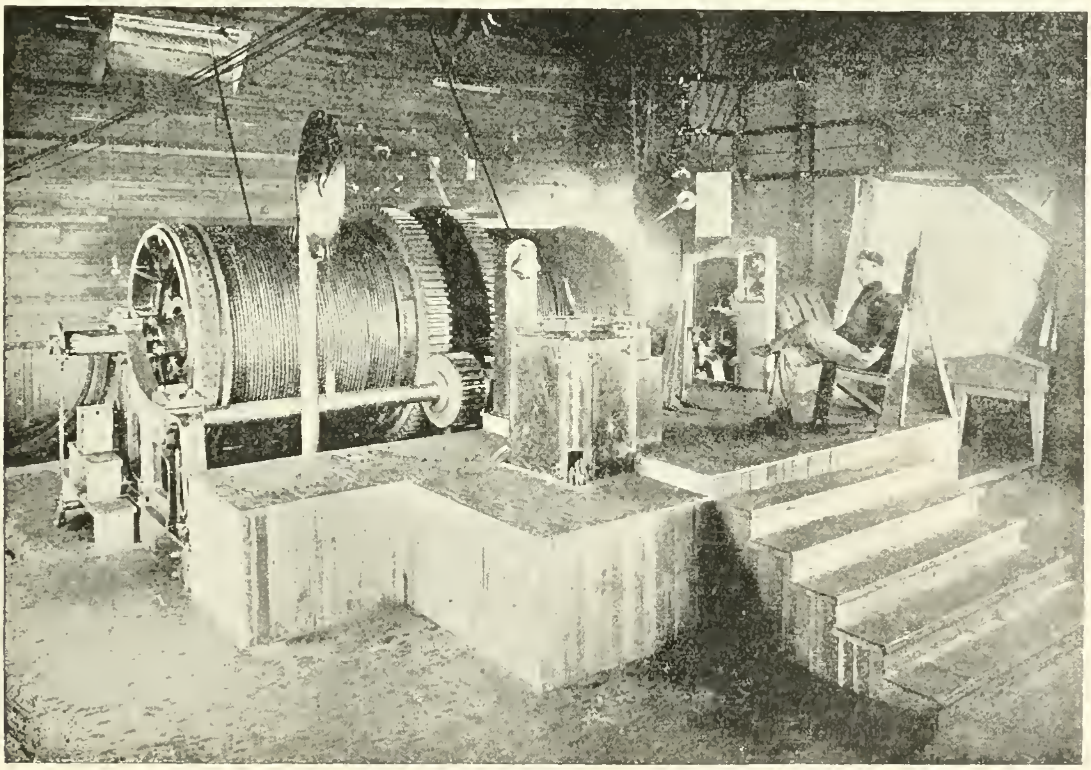


FIG. 14.—GENERAL VIEW OF INDUCTION HOISTS AT WAR EAGLE MINE.

The next feature of interest in the electrical installation at the War Eagle mine is found in the 300-kilowatt synchronous motor operating the 40-drill compressor illustrated in Fig. 15. Three-phase current at 2,300 volts is applied to this motor, which runs at 200 revolutions per minute. It is of the revolving armature type, has thirty-six poles, and, consequently, bears the designation "A P 36-300-200." A General Electric multipolar exciter, not shown in the illustration, is driven from a large pulley on the free end of the motor shaft, and this exciter has an output of nine kilowatts at 125 volts when operated at 1,450 revolutions per minute. The compressor, which is of a double duplex type, is driven through independent ropes applied direct as shown in the illustration.

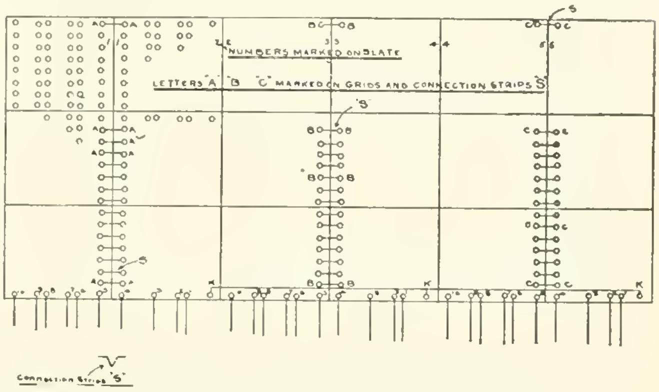

Numbers marked on slate
Letters "A" "B" "C" marked on grids and connection strips "S"
"S"
Connection Strips "S"

FIG. 13.—ASSEMBLY DIAGRAM OF STATIONARY CAST IRON RESISTANCE.

The method originally installed for starting the synchronous motor is also shown in the illustration given, and it consisted of a thirty horse power induction motor belted to a counter shalt through a friction clutch, this shaft carrying a spur gear by means of which the armature was brought up to speed. It can not be said that this equipment has been satisfactory, although it is in practical operation. The difficulties in its use rest, first, in the fact that in bringing the armature up to synchronism the compressor must, as well, be brought up to speed; and second, the 30 horse power motor is too small for the duty required. It takes most exactly eight minutes to bring the motor up to synchronism, in doing which the 30 horse power induction motor delivers from 120 to 130 horse power, and, incidentally, has its temperature raised to a point somewhere above that conducive to a ripe old age. Although the small motor was still in service at the time of the writer's visit to the mine, it was shortly to be replaced by one having more than double its capacity. It should be stated in justice to the engineer of the Kootenay company that the starting device here discussed was not of his design or sanction. With the exception of the time consumed in starting, the equipment gives the best of satisfaction. A number of small motors ranging up to 20 horse power in capacity are used in and about the War Eagle mine for ventilating purposes, driving conveyors, etc., and all these motors are of the induction type except that on the compressor.

At the Iron Mast mine is a 75-kilowatt "S.K.C." synchronous motor, made by the Royal Electric Company, of Montreal. It is a two-phase motor, with connections altered for three-phase service, and is started through an "S.K.C." induction motor and water rheostat, both of which appear in the illustration shown in Fig. 16. The water rheostat consists of three fan-shaped blades plunged edgewise into a three-compartment tank of water, thus enabling the water resistance cut into each leg of the three-phase circuit to be varied according to the depth of immersion. The 75-kilowatt motor is belted to a jack shaft in the manner shown, which drives two double-acting compressors having a combined capacity of ten drills. This is the only Stanley equipment on the West Kootenay circuit, and its service is most reliable.

In the Big Three mine is a 75-kilowatt General Electric synchronous motor, driving a seven-drill compressor in the manner shown in Fig. 17, while at the Gertrude mine is a 50 horse power induction motor operating a hoist. The British Columbia Bullion Extraction Company has one 50 horse power induction motor driving a rock breaker, and one 75-kilowatt synchronous motor operating all machinery about the mine, including generators for electrolytic work.

These motors, as well as all others referred to hereafter, are of Canadian General Electric manufacture. In the properties of the British-American corporation are four 150 horse power induction motors, each operating a double drum hoist through equipments which are in every way similar to those at the War Eagle mine. All underground work in and about Rossland is operated at 220 volts. Aside from mining work, the principal power installation is that of the general machine shop of Cunliffe & Ablett, where a 50 horse power induction motor is installed. There are many small motors ranging from one to five horse power in size for furnishing of light power in different industries in Rossland.

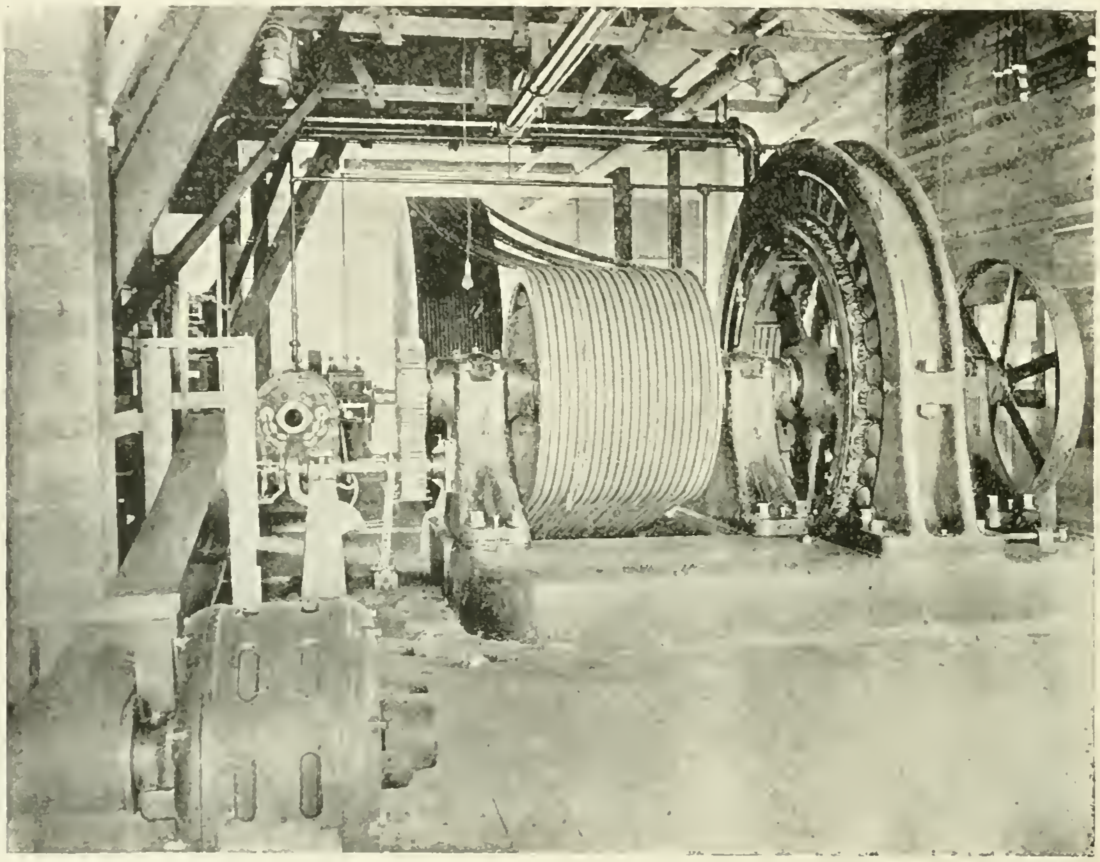


FIG. 15.—VIEW OF 400-H.P. SYNCHRONOUS MOTOR, DRIVING 40-DRILL COMPRESSOR AT WAR EAGLE MINE.

One of the most interesting points to be brought out by the Kootenay-Rossland transmission is the demonstration of the fact that the operation of synchronous and induction motors in large units for the driving of hoists and compressors will not necessarily create serious disturbance in the voltage of the distribution circuits, provided high voltage, ample fly-wheel effect and capacity prevails. During daylight the power and lighting circuits are operated in parallel, although they are separated and operated independently from the power house by night. The War Eagle hoist, however, is operated on an independent circuit by day, but at night it is cut into the power circuit at the Rossland sub-station. The result of this arrangement is shown in the reproduction of the recording voltmeter chart shown in Fig. 6, which is that of the lighting circuit. From 6:45 p.m. to 5:00 a.m. the chart shows the regulation of the lighting circuit when on an independent line from the power house. At 5:00 a.m. the War Eagle hoist is taken from the power circuit and put on an independant line to the power house, and the remaining power load is coupled in with the lighting load and carried on the second line to the power house. The voltmeter curve, therefore, from 5:00 a.m. to 6:45 p.m., shows the regulation of the plant when all power with the exception of that for the War Eagle hoist is in parallel with the day lighting load. The chart given is that for an ordinary day, and, indeed, the charts run so evenly from day to day that each almost duplicates the other. The day in question there were in operation from 5:00 a.m. to 6:45 p.m. three 100 horse power syochronous motors with an average load of 280 horse power on compressor work; five 50 horse power induction motors with an average load of 210 horse power on the same, three of which were on hoists; three 30 horse power induction motors with an average load of 76 horse power, and one 40 horse power induction motor carrying an average load of 32 horse power. The lighting load consisted of 300 horse power, which is high in proportion to the night lighting load because of the heavy 24-hour load carried. The report from the generating station for the same day shows that the variation reached 108 amperes at 110 volts, or an approximate variation of 205 horse power, considering which the regulation is remarkably good. The secret of this is stated to lie in always maintaining a high voltage in relation to the motor ratings, with ample generator and wheel capacity.

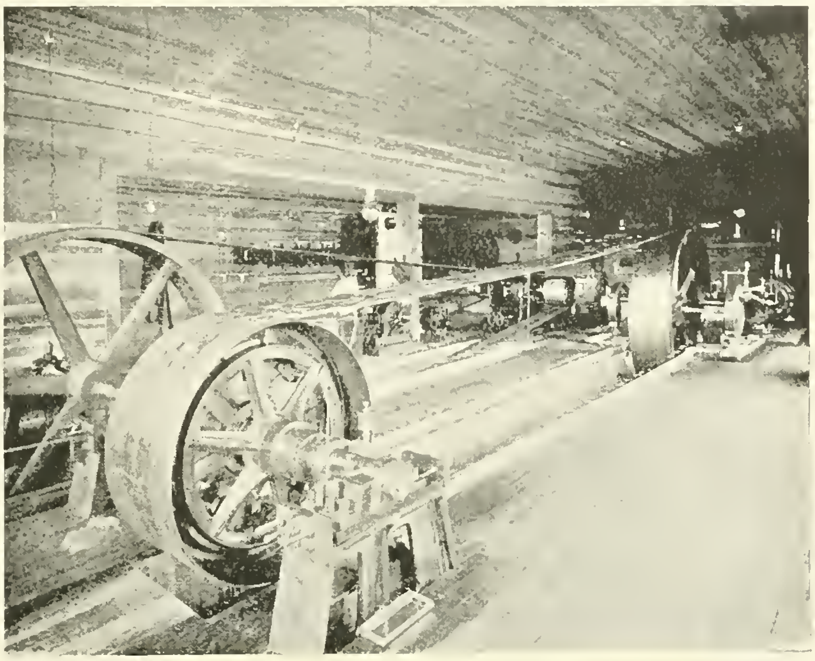


Fig. 16,—Stanley 100 Horse Power Synchronous Motor, Driving 10-Drill Compressor at the Iron Mask Mine.

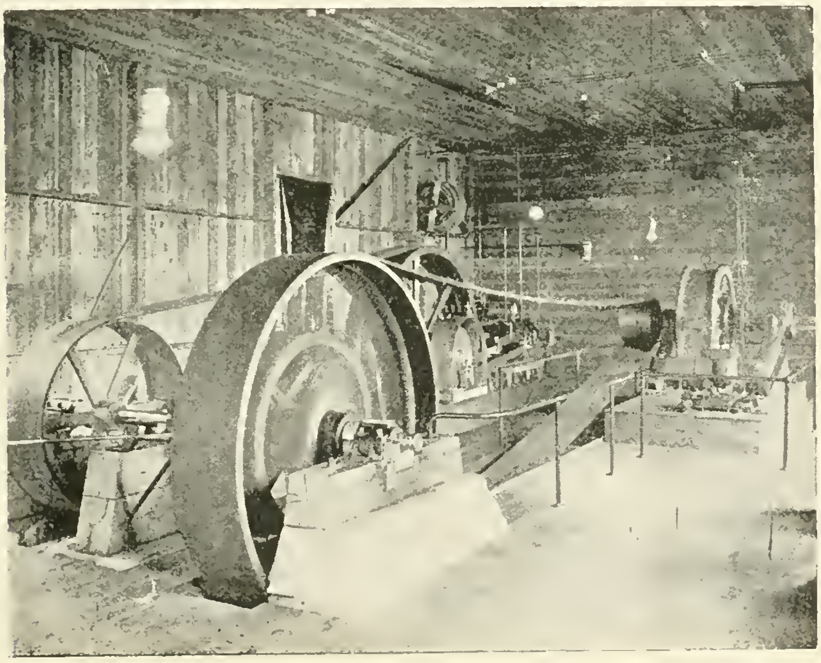


Fig. 17.—100 Horse Power Synchronous Motor, Driving Seven-Drill Compressor at the Big Three Mine.

The construction of electric railways in Chatham and Sarnia, Ont., is being advocated.

THE CANADIAN ELECTRICAL ASSOCIATION.

Under the direction of the new president, Mr. A. A. Dion, a meeting of the Executive of the above Association was held at the Russell House, Ottawa, on September 14th. Besides closing up satisfactorily all matters in connection with the last annual convention, the committee discussed at some length the work which should engage the attention of the Association during the present Association year. This work has been allotted to various committees, which will be called together at an early date.

The Committee on Meters has been requested to devise some satisfactory scheme for the re-inspection of meters which will entail less expense upon the lighting companies than is imposed by the existing regulations. The Government Inspection Department is understood to be desirous of meeting the wishes of the companies in this regard, if a satisfactory scheme can be propounded. The view urged by the Association, as representing the companies, is that the present inspection fees should cover the cost of re-inspection during the period for which the meters are sealed, or that if a second fee be necessary, it should be for a nominal amount. Experience is said to have demonstrated that watt meters do not accumulate as much dust and consequently are less liable to disarrangement with the alternating as with the direct current.

A public meeting was held in the village of Erin, Ont., recently to discuss the question of installing an electric plant for lighting the streets. A committee was appointed to ascertain the cost of lighting in other places.

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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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Steam Ploughing.

AN illustration of the growing application of steam power for agricultural purposes was given last month at Morden, Manitoba, where a test was made by the Canadian Pacific Railway Company of a steam plough. The machine moved at a speed of one and one-quarter miles per hour, and dragged after it a gang of ten ploughs, which turned over a width of twelve feet of earth, of the depth of four inches. The fuel used was the herbage which had grown on the prairie common to the western country, and which had been cut down a few days previously. We are told that the fly-wheel moved at the speed of 203 revolutions per minute, and the driving wheel of the machine at four and one-half revolutions. At the speed at which the test was made, the ploughing done in one day would be about 20 acres. As the price paid for ploughing in the North-West is said to be about three dollars per acre, it would seem that from the point of economy the steam plough is a success. That they will come into more general use is almost a certainty. In Germany, for instance, steam ploughing is said to be very largely adopted.

Fixed vs. Moveable Coils.

IN dynamo design, a debatable question at the present time is the relative superiority of moving or fixed coils. Elsewhere in this issue Mr. W. A. Johnson presents arguments in favor of the type of machine with stationary wire, contending that the two coil inductor alternator overcomes the objections of bad regulation and over-heating which may be made against the single coil machine. In European countries this question is also receiving some attention, and it has by no means been decided which method of construction possesses the greater merit. Although the idea of the inductor alternator was conceived twelve years ago, it is only recently that a machine of this pattern became one of the standard types of the Brush Company. They have now been installed in some of the largest electrical works, and are said to be giving satisfaction. On the other hand, a correspondent writes to a British exchange that there is a tendency on the part of Swiss dynamo makers to return to the revolving coil machine. We are not told, however, whether or not more than one field has been employed.

The Storage Battery.

DR. N. H. Edgerton, of Philadelphia, is building a factory in the city of Hamilton, Ontario, for the manufacture, on a somewhat extensive scale, of the high tension battery of which he is the inventor. Considering the limited demand as yet in Canada for the storage battery, this is a strong indication of the faith of Dr. Edgerton in the future of storage batteries generally and of his invention in particular. As it is said to be the intention to employ some fifty workmen, the question of a market for the output of the manufactory suggests itself. This is in part answered by the fact that the Cataract Power Company, which has already secured control of several electric railways in and around Hamilton and contemplate building other new roads, are very likely to install a storage battery system as an auxiliary to their railway power plant. From this it may be judged that the promoters of this manufactory anticipate a much greater use of the storage battery for railway purposes, not for direct operation, for which they have not been found satisfactory, but as an auxiliary plant. If the storage battery should be employed in this manner by the Cataract Power Company and be found satisfactory, it will undoubtedly result in other companies following in their footsteps, and will give encouragement to the storage battery industry in Canada.

Extension of Canadian Telegraph System.

The Dominion government is about to undertake the construction of two quite important extensions to its telegraph system, both of which will involve rather uncommon engineering features. One of these is a line from Lake Bennett to Dawson city, in the Yukon district, for which three hundred and thirty thousand pounds, or one hundred and sixty-five tons, of iron wire will be required. The second is the extension of the Gulf of St. Lawrence telegraph system from Big Roumaine, Quebec, to Chateau Bay, Labrador, opposite Belle Isle, a distance of 315 miles, and which has been frequently asked for by the shipping interests. In connection with the latter extension, it is not improbable that wireless telegraphy will be employed to communicate between Chateau Bay, on the Labrador coast, and Belle Isle. It is said that the experts are as yet undecided as to how the connection will be made. The laying of a cable would be the most simple method, but it is feared that it might be broken by the grounding of icebergs in this narrow strait. About the only alternative, therefore, seems to be the adoption of a system of wireless telegraphy, and this course is understood to be under consideration. The demonstrations that have been made of this system would seem to place its practicability beyond question, and its adoption in Canada to a greater or less extent may be expected to follow in the near future.

Pumping Water by Electricity.

The Cataract Power Company have made another proposition to the city council of Hamilton to pump the water supply of the city by means of electricity, instead of steam, now employed. The revised offer is said to be more favorable than the previous one, and there is a probability that eventually satisfactory terms for performing the service will be reached. The Cataract Power Company contends that by the introduction of electric power a considerable saving in cost of operation can be effected. The pumping of water by electricity, not a new idea, opens up another field for the central station manager to exploit in his search for a market for the output of his station. Where the water supply is pumped by electricity, it may be found expedient by some cities and towns to adopt a system of water purification by means of the electric current. We observe that in St. Louis such a method has been adopted with satisfactory results. The system consists in admitting the water to be purified into a tank divided into small compartments. In each of the latter a pair of electrodes are located, the positive being attached to the bottom of the compartment, while the negative floats upon the surface of the liquid. As these receptacles are presumably non-conductors of electricity, when the current is turned on it naturally passes through the water from the positive to the negative electrode, and by decomposing it liberates hydrogen, which escapes to the surface, carrying with it all foreign matter and impurities. In Paris, France, the Tindal system is in use. This consists in forcing air that has been subjected to the action of a high tension elecric current, and thereby ozonized. into the water to be purified. The cost is given as .028 of a cent to sterilize one cubic yard of water, which certainly seems very reasonable.

The Record of Acetylene.

The Canadian Manufacturer, apparently with the object of securing the favor and incidentally the advertisements of the manufacturers of acetylene gas machines, charged this journal with having misrepresented the extent of the development of acetylene lighting by publishing statistics compiled by the Canadian Electrical Association. Our answer showed clearly that no responsibility attached to us for the correctness or otherwise of these statistics, which were published as a part of the proceedings of the Canadian Electrical Association convention. The Manufacturer, evading entirely this, the main point, in our reply, returns to the attack in this manner: "Our esteemed contemporary gives itself away, for in the very letter that it alludes to from a manufacturer of acetylene gas machinery, data is given that disproves the assertion that there are only 155 machines in use in Canada. If the Electrical News desires to verify its unverified statement, we will have pleasure in giving it the names of a few Canadian concerns whose annual output each is in excess of the gross number mentioned in the statement alluded to." As to the correctness or otherwise of the statistics published, the editor of The Manufacturer should have addressed himself to the Canadian Electrical Association, under whose direction the figures were compiled and given to the public. Incidentally it might be mentioned that the editor of The Manufacturer "gives himself away" when he alludes to data given in the letter of a manufacturer of acetylene apparatus, mentioned in our previous reply, which letter, through an oversight, was not published in our September number.

LIQUID AIR.

Prior to 1887, says the Engineer, air was thought to be a permanent or incondensable gas, but it was liquefied simultaneously by Messrs. Pictet and Caillete at that time, though at an enormous expense. About 200 years ago the lowest temperature thought to be obtainable was produced by a mixture of snow and ice, and was used by Fahrenheit in establishing a zero for his thermometric scale. Since that time scientists have reached a temperature some 400 degrees below the lowest point ever reached by Fahrenheit. Of the three known methods for producing cold, the first, i.e., by the rapid solution of a solid was used entirely up to 1820 and yielded a temperature of 50 degrees below zero centrigrade. The other two methods are the rapid evaporation of a volatile liquid and the rapid expansion of a cooled and compressed gas. By a combination of pressure and refrigeration, Faraday in 1823 liquefied all except six of the existing gases, but it was not until 1869 that it was discovered that these gases must first be cooled to a critical temperature. By subjecting hydrogen to an enormous pressure and at the same time lowering its temperature it was found possible to liquefy it. Hydrogen has a critical temperature only 33 degrees C. above the absolute zero of temperature. From the experiments performed, the conclusion was drawn that solids, liquids, and gases were but different forms of matter through which any substance could be made to pass by the addition or withdrawal of heat and pressure.

THE DIRECT CURRENT MOTOR.*

By L. A. Herdt, Ma. E., E. E.

Dynamo electric machines belong to the class of machines which are called reversible. This does not mean that they can be run backwards, but that the transformation of energy which goes on in the machine is reversible.

If we apply mechanical energy to a dynamo so as to make it rotate, it will generate a current of electricity. This current we can send to a distance through conductors, let it enter a machine, another dynamo, and this machine will start to rotate and convert the current or electrical energy supplied to it into mechanical work—the motion of visible masses of matter. In this accomplishment we started out with mechanical energy, and come back to it far from its first application. Electricity in the transformation has only been a link, a means of transmitting the power. Motion is necessary to produce the current, and the dynamo or motor is merely a device for transforming what is called energy from one form to another.

A motor is therefore the same machine as a dynamo, or a dynamo to which a current is supplied. Therefore, in studying the inner working of a motor, we must deal with exactly the same principles that we find at work in dynamos. The main parts which are to be considered in a dynamo are the field magnets and the armature. The field magnets, which produce the magnetic field, are usually stationary; the armature, the part in which the currents are induced, revolves.

A commutator is also required, either to carry the current generated in the conductors of the armature to the line, as in a dynamo, or to conduct the current from the line to the conductors on the armature, in the case of a motor.

If a conductor forming a loop is moved across a magnetic field, a current will flow in this conductor; this current will be generated as long as the motion lasts, and the moment that it stops the current will vanish; also, if a conductor carrying a current is placed in a magnetic field in a plane at right angles to the magnetic lines, it experiences a force urging it to move in that plane. The motion will last as long as the current is flowing in the conductor and as the conductor is still in the field. Motion is therefore necessary to produce the electric current, and the electric current will in turn produce motion.

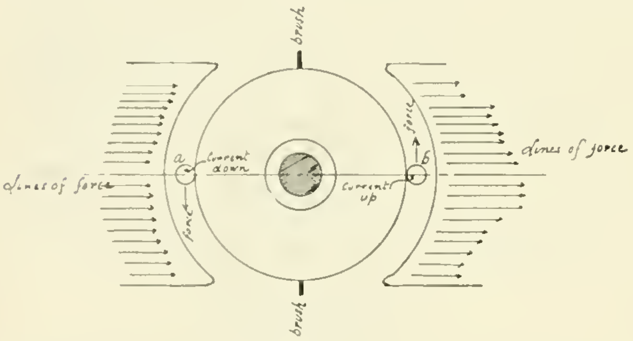

FIG. 1.

The armature, as found in dynamos, is simply a collection of loops of wire so arranged that each conductor in its rotation between the field magnets is carried past these field magnets, and current is generated in these conductors. In a motor, the conductors carrying current and placed in a magnetic field are subjected to a force which, as will be presently explained, produces a rotation of the armature.

Fig. 1 shows a section of an armature and pole pieces of a dynamo. This section is in a plane at right angles to the shaft; a and b are two conductors forming a part of the same loop, the currents in these being in opposite directions. It will be found that conductor (a) will be subjected to a force acting downwards, while the force on (b) will be upwards, the effect of these two forces, as will readily be seen, being to turn the armature about its axis. If any number of conductors are arranged on the surface of this armature, the forces acting on these conductors will be all downwards on one side of the brush plane and upwards on the other side. These forces, acting on the conductors at a certain distance from the axis of the shaft, results in a twist, so that the shaft will be turned. If we were to rotate by hand the armature of a small dynamo, we would find that as long as the dynamo is not made to generate any current, the resistance to turning the armature would be very small. As a matter of fact, this resistance is that simply due to the friction of the shaft in its bearings, and the friction due to the pressure of the brushes on the commutator. But if we should now close the circuit of the dynamo so that the machine will generate a current, the force that we shall have to exert to keep the machine rotating is many times greater, for since the conductors are now carrying current, the force which we find acting between magnetic fields and conductors carrying current is acting against the imparted motion of the dynamo.

In a motor this force is the one which causes the machine to rotate, and is therefore acting in the direction of rotation.

It seems puzzling to the mind of the unacquainted observer how it is that so much force has to be exerted to drive a dynamo under load; the armature revolves between the polar pieces quite freely, the mechanical friction can absorb but very little power, then what becomes of the surplus power which is mechanically imparted to the machine. The answer is, that there is a force which the magnetic field exerts on the conductors of the armature since they now carry current; this force or drag opposes the rotation, the larger the current in the armature the greater this drag and the more the power which is required to keep the machine revolving.

In a motor this drag is the driving force, and is the one which produces the rotation.

THE STARTING OF ELECTRIC MOTORS.

In starting an electric motor from a stand-still, it will be found necessary to introduce a resistance in the armature circuit of the motor, this resistance to govern the current and reduce it to any desired flow. At starting, or when the motor is running slowly, the current has to go through a resistance box called starting box, and then through the conductors of the armature; the field coils are either connected directly to the line as in shunt-wound motors, or in series with the starting box and armature as in series-wound motors. The current strength is therefore given by the ratio of the electro-motive force of the line and the total resistance introduced in the circuit. In order to speed up the motor, the resistance of the starting box is gradually taken out, until the motor is placed directly on the line and is then running at its rated speed.

Without this resistance at the start, the current that would go through the motor would probably be excessive and prove injurious to the insulation of the armature; besides it would not be doing useful work, for useful work is only done when the armature revolves. The current at start should be large enough to start the rotation, but not large enough to injure the motor.

If the resistance in circuit is now cut out gradually the motor will speed up, and it will be found that the faster the motor runs the weaker the current becomes. This is due to a generating action taking place in the motor itself on account of its speed, in fact the motor by its rotation is now working as a dynamo on its own account and tends to generate a current in the circuit in the opposite direction to that which is driving it. As the production of current is due to an electro-motive force, this generating action taking place in the motor will be found to be due to an electro-motive force acting as soon as the machine is rotating. This electro-motive force, which is called a counter electro-motive force, varies with the speed, that is, increases or decreases with the speed. The current now does not depend on the electrical resistance of the circuit alone, but is checked by this electro-motive force of reaction which is working against the electro-motive force of the line. Therefore, whereas in a generator there is only one electro-motive force acting, in a motor there must always be two as soon as the machine is developing work, that is, as soon as the machine is rotating.

The electrical energy supplied to a motor is measured by the product of the voltage on the line into the current flowing; this product is expressed in watts, and if divided by 746, will give the electrical horse power delivered to the motor. This energy, usually called the electrical input, is, however, not wholly converted into useful work, and only a portion of this (happily a large one) will be available on the shaft.

The energy supplied is expended in two ways, in heating the circuit and in doing work. The expenditure of energy in the form of heat is the product of the resistance of the circuit into the square of the current. This product is expressed in watts, and may be termed heat watts. This amount of power is lost and simply heats up the machine; to reduce this loss will be to make the resistance of the armature as small as possible. The difference between the total watts supplied to the motor and the heat watts may be called the mechanical watts, that is, it is this part of the total energy which will be transformed in the machine from electrical to mechanical energy. These mechanical watts, however, may be divided into two, those which are utilized in doing useful work, and those which are required to overcome the internal resistance to motion.

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* Abstract of a lecture delivered before the Y.M.C.A. Electrical Club, Montreal, by L. A. Herdt, Ma. E., E. E., Lecturer in Electrical Engineering at McGill University.

For example, in all motors a certain amount of work is required to overcome the friction of the bearings, the friction of the brushes on the commutator, the resistance of the air, and such effects known as hysteresis and eddy currents. The energy required to overcome these must evidently be drawn from the supply, and amounts to a certain loss, and the aim of the designer is to reduce these to a small value. The rest of the mechanical watts, usually called the useful watts, are available for useful work ; that is, the energy available on the shaft of the motor.

"En resume," we see that, of the electrical horse power delivered to a motor, only the useful mechanical watts are available for doing work ; the ratio of these to the electrical input in watts is called the efficiency of the motor. The electrical input is easily measured by means of an amperemeter and of a volt meter.

The mechanical output can be measured in different ways, one method being by a brake, such brake to be in the form of a prony brake, which is well-known. This brake consists in clamping on the pulley of the motor a pair of wooden jaws which absorb the power. Sometimes it consists of a rope passing over the pulley, the pull on the rope being measured by means of a scale. If p is the pull in pounds on this rope, and r the radius of the pulley over which the rope is passed, the twist on the shaft retarding the motion is equal to pr. If the pulley revolves at a speed of n revolutions per second, the speed of the periphery of the pulley is equal to $2\pi rn$. Now, the work is the product of the force by the velocity at the circumference, therefore the work absorbed in foot pounds by the brake $= p \times 2\pi rn$. Now, 550 foot pounds per second equals one horse power, therefore the horse power absorbed by the brake is equal to $\frac{2\pi rnp}{550}$. This measures the output of the motor.

INHERENT REGULATION IN INDUCTOR ALTERNATORS.

By W. A. Johnson.

It should not be necessary to call the attention of the buyers and users of electric machinery to the great desirability of having practically perfect regulation in any dynamo, but this important feature is very often overlooked. By perfect regulation is meant that all ordinary changes in load, from the throwing on or off of lamps, should not cause change in pressure of more than 2 per cent. The usual guarantee of engine builders at the best is but a regulation of two per cent., consequently the dynamo builder is limited to this percentage, as the regulation of dynamo can be no better than the constancy of the speed, as governed by the engine or water-wheel, allows of. It is well known that direct current dynamos are turned out by makers of high grade machines that will give a regulation of 2 per cent., but until recently no inductor alternator has been able to show anywhere near the result.

Good regulation means longer life of lamps, greater satisfaction to the customers, less attention to controlling rheostat, and it generally means a cool running dynamo (unless the dynamo is overloaded). Not only is this true of direct current dynamos, but to much greater extent with alternating current can the greater advantages of perfect regulation be claimed as the most essential point to consider in the selection of a machine, as without proper design the false currents generated in the iron of the machine through lack of magnetic balance necessarily result in excessive heat, bad regulation and low efficiency, and especially is this true in the inductor type of dynamo. The principal reason why one or two of the older manufacturers of alternating dynamos have adhered to machines having moving wire instead of adopting the inductor type, is that most inductor dynamos on the market have extremely bad regulation, and necessarily, through hysteresis losses, low efficiency. Therefore, one or two of the larger manufacturers are still adhering to the old type of moving wire machines, obtaining regulation through complicated composite windings, rectifiers, etc., and of course retaining all the attendant disadvantages of such construction. The mechanical and commercial advantages of the inductor dynamos are so obvious, however, that a machine overcoming the objections mentioned should meet with the approval of all users. It is possible to design an inductor alternator of such construction that perfect inherent regulation within two per cent. can be obtained for all ordinary changes in load, such as throwing on or off the lamps in a theatre, church or any large building, say 250 lamps on a 1000 light machine, and proportionally on larger sizes. In fact, fully one-third of the capacity of a machine has been cut off with a momentary fluctuation of but one and one-half volts, the needle setting back in a few seconds to standard voltage.

This is far closer than has been obtained before with inductor alternators, and absolutely does away with constant attention to the rheostat (except for change in speed) after the dynamo and line is at working temperature. This is a stronger claim than can be made for the composite wound machine under the usual working conditions. Now, how can this close inherent regulation be obtained? Only in a machine having magnetic symmetry.

This is the key note of dynamo design, and if lacking in an inductor alternator, then through the irregular action of the magnetic flux the different parts of the iron frame and the armature core will run hot, communicating this heat to the windings of the armature and field coils, rendering them incapable of carrying at a reasonable temperature the full current load that the cross section of copper provided would otherwise allow, and in some machines this wasteful magnetic heat has been communicated to the bearings, causing these to overheat and necessitate shutting down.

A machine without magnetic symmetry will overheat at even light loads, thus proving the rule as to temperature, whereas a machine of proper design will remain practically constant in temperature at all loads or until the capacity of the copper windings is fully attained.

To sum up, the claim is made that the successful dynamo or motor (following in design the present recognized theories of magnetic changes) having but a single magnetizing field coil, it matters not whether the machine be for alternating or direct current, is yet to be designed, and that any single coil machine is and will be defective, inefficient, regulate badly, overheat through hystereris, and that a two-coil inductor alternator of proper design overcomes all the objections mentioned.

This theory was enunciated by us as far back as 1885, and has been reasserted in printed matter we have issued at several later periods, and while it is an extremely simple point not in any case claimed as original with the writer, as it has evidently been recognized by designers of multipolar machines, perhaps, however, inadvertadly, as the use of the multipolar type of field originally arose from the desire to obtain low speed and subdivision of current in commutation of direct current machines, yet in the inductor type of alternator the use of more than one field has been entirely overlooked by all manufacturers.

A machine embodying the very desirable feature of close inherent regulation is now manufactured in Toronto by the United Electric Company, Limited, and the correctness of the theory as herein stated is proved by the fact that this machine has practically no magnetic heating in the ordinary sense of the term in the iron or steel of any portion of the frame, inductor or armature core, in fact, under test at overload, it having been under 30 degrees Fahrenheit above surrounding atmosphere after a previous full load run of fourteen hours.

PERSONAL.

The congratulations of many friends are being extended to Mr. W. A. Martin, secretary of the Toronto Electric Light Company, upon the occasion of his recent marriage to Miss Bowling.

The exhibitors in Machinery Hall at the late Toronto Industrial Exhibition presented Mr. T. Eversfield, chief engineer of the hall, with a bedroom set and an address expressive of his kindness and consideration during the fair.

The news has been received in Montreal of the marriage in England of Mr. Ernest G. Coker, B.B., B.Sc., assistant professor of civil engineering in McGill University. Professor and Mrs. Coker were expected to arrive in Montreal about the end of September.

Mr. John J. York, chief engineer of the Board of Trade building, Montreal, has tendered his resignation, to accept a similar position at the St. Lawrence Sugar Refinery. He has been succeeded by his brother, Mr. B. A. York, who for the past four years has been inspector for the Boiler Inspection and Insurance Company of Toronto.

Mr. W. J. Johnston, late editor of the Electrical World, of New York, is at present on a tour around the world. Mr. Johnston sailed from San Francisco, the first stages of his journey being the Hawaiian Islands and Japan. In the Orient, Korea, China, Manila and Java will be visited, and about six weeks passed in India. The entire trip will occupy about eight months, and comprises visits to Egypt and Turkey.

BY THE WAY.

WHEN old timers in various departments of the electrical business get together, they are apt to indulge in reminiscences of an interesting character. The old telegraph man by way of illustrating the resourcefulness of the pioneers, will tell how a stove pipe was once utilized to make contact between the ends of a broken wire when nothing better adapted to the purpose was in sight, and how to everbody's surprise it did its duty nobly and well. Another will describe the first insulated office wire as having a covering of hemp and red sealing wax. At this point the electric light man will probably start in to prove that expensive insulation is not as necessary for the prevention of fires as it is supposed to be. By way of experiment he once put up a number of 52 volt incandescent lamps on bare wires placed in contact with wood, then turned on the hose and no fire resulted. The electric light man believes, and there appears to be ground for his opinion, that the fire underwriters' regulations governing the method of wiring, should take the voltage into account. He also thinks that it should be made permissible if not compulsory, as in England, to ground secondary wires, to prevent trouble from contact. These and many other subjects of equal interest engage the attention of the old timers when by chance they meet.

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"AN odd institution that has lately come under my notice," said a friend of mine the other day, "is the railway, twelve miles in length, between Grenville and Carillon on the Ottawa river. This railway is employed for the transport of passengers and baggage coming by steamer from Montreal to Ottawa and vice versa. The train, which consists of a locomotive and one car, makes only one trip per day, leaving Carillon on the arrival of the boat from Montreal, and on the return, leaving Grenville on arrival of the steamer from Ottawa. The line runs through fields some distance from the river. The roadbed and rails cannot be seen except at close range, being overgrown with grass. At a glance the engine is seen to be an old timer and probably will not stand a pressure of more than 30 to 40 pounds. It looks very like the first locomotive put into service on the old Northern Railway, and which I understand was built at Good's foundry on Queen street, Toronto. An old gentleman, grey haired and grey bearded, attired in a long black coat, white tie and high collar, and presenting the appearance of a superannuated Methodist preacher, occupies the dual position of conductor and brakeman. Notwithstanding his antiquated appearance, however, he seemed to be rather more than up-to-date in his movements, for on the whistle sounding 'down brakes,' he responded so quickly that the locomotive and car were brought to a stop some distance before the platform which does duty as a station, was reached, and the train had consequently to be started up again to reach its destination." In concluding his description, my friend remarked that the old conductor must have a great task on his hands in making up his daily returns for the railway company.

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THE electrical situation at Ottawa is at present an interesting one. Speculation is being indulged as to the outcome of the efforts which are being made to subject to competition the Ottawa Electric Company, which until now has furnished the entire supply of electricity for public and private purposes. The Deschene Electric Co., which failed to secure a franchise, has gained an entrance to the city over government property alongside the canal, in return for lighting the canal. Thus far the company are lighting only one or two of the large buildings, and it seems doubtful whether they will become an important factor in the situation, as they are not allowed the use of the streets. The Metropolitan Electric Company has been organized and has obtained a franchise from the council, to utilize a water power seven miles distant to generate and transmit electricity for light and power to the city. This enterprise involves the construction of a canal at considerable cost. The company are doing some preliminary work in the neighborhood of the water power, but it is said are experiencing difficulty in getting the requisite capital subscribed. The opinion is expressed in Ottawa, that the company would prefer to sell out to the Ottawa Electric Co., if the way should open up for satisfactory negotiations. It is also reported that the Ottawa Electric Company have an option upon an equally good water power situated two or three miles nearer the city. Perhaps the best available water power is one situated on the Ottawa river, about 35 miles above Ottawa. Here a natural dam is formed by several islands with narrow spaces between. This power, which is the property of the Quebec government was recently offered for sale by auction. A condition was that the purchaser must expend the sum of $300,000 upon development work, which had the effect of preventing offers. The fact that Nature has left so little to be done for the development of this power, should have prevented the insertion of such a condition. There are numerous water falls on the Gatineau, but the turbulency of that stream is such that the still water necessary to the avoidance of anchor ice, prevents their utilization for electrical purposes.

SPARKS.

The power house of the Canada Electric Light Co., at Amherst, N. S., was partially destroyed by fire on September 19th. The loss is believed to be covered by insurance. N. A. Rhodes and D. W. Robb are members of the company.

As a result of recent labor troubles in connection with the operation of the street railway at London, Ont., the council is said to be considering the purchase of the street railway property and its operation by the city as the best means of putting an end to the present unfortunate condition of affairs. In the event of being unable to buy out the existing company, a rival road is spoken of.

Application has been made to the Ontario government for the incorporation of the Port Stanley Electric Railway Company, to construct an electric railroad from Port Stanley to St. Thomas and London. The road, it is thought, could be constructed and equipped at an outlay of a quarter of a million dollars. The promoters of the scheme are the London and Port Stanley Gravel Road Company, who talk of having the road completed by May 24th next.

News has come to hand of the death, under distressing circumstances, of Mr. W. A. M. Pollock, electrician at the electric light station at Almonte, Ont. Deceased was engaged in rubbing powdered resin on a revolving pulley to keep the belt from slipping, and was standing in a narrow space at the end of shafting. By some means his right arm was caught in the belt, and he was thrown head foremost between the pulley and the bridge-tree. He was carried half way round the pulley and suspended head down, being wedged in the narrow five inches of space between the pulley and the bridge-tree. When extricated it was found that the arm of the deceased had been wrencbed off at the elbow, and that he had received other serious injuries. Medical assistance was at once procured, but Mr. Pollock succumbed to his injuries in less than three hours. Deceased was a respected and well known resident of Almonte, and leaves three small children. He had been employed by the Almonte Electric Light Company for thirteen years.

UNDERGROUND CONDUIT FOR ELECTRIC WIRES.

The City Council of Ottawa, through its Fire and Light Committee, a few weeks ago instructed the city engineer, Mr. John Galt, to report upon the feasability of placing the electric light, telegraph and telephone wires underground. Mr. Galt's report, together with a preliminary sketch showing the proposed method of subway construction, will be found below :

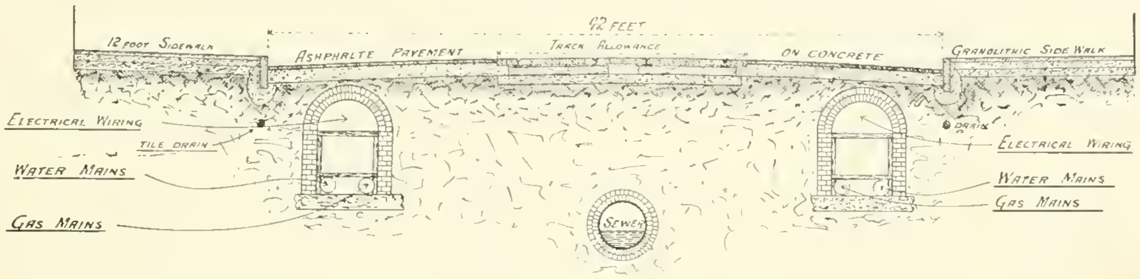
To Chairman and Members of Fire and Light Committee:

GENTLEMEN,—Acting upon your instructions to investigate and report upon the feasability of having all electric wiring underground, so as to obviate the nuisance of the overhead system constructed and carried upon unsightly poles along the streets of the city, I beg to report as follows :

Underground wiring is quite practicable from a civil, mechanical and electrical standpoint, notwithstanding the objections, difficulties and obstacles to be encountered.

The most important feature to be considered from the standard of municipal requirements is the system of underground work. The ideal method, unquestionably, would be separate open subways on each side underneath the sidewalks or along the street roadway, close to the gutter or curbing, large enough in size for the accommodation of water, gas, electric wiring, etc., including facilities for examining, making repairs and house connections.

This seems to be the only suitable plan of subway construction, and will give separate underground space on each side of the street for pipes and wire service to the street line. Of course this, you see, would require duplicate water and gas mains, but there could be no objection outside of the extra cost, because in the central portion of the city this is both desirable and highly advantageous, subway or no subway.



PROPOSAL FOR UNDERGROUND CONDUIT—CITY OF OTTAWA.

My conclusions are as follows :

(1) In cities overhead wiring is highly objectionable from every standpoint.

(2) Underground systems are practicable for all kinds of service, notwithstanding the serious objection urged, including interference on account of electrical induction.

(3) A single subway in the middle of the street, although practicable, is entirely unsuitable, because connections to house property would require constant cutting up and repairing of streets.

(4) It is more than apparent, without further explanation or illustration, that under municipal ownership the extent and interference in the tearing up of streets will be reduced to a minimum.

(5) In the end the results will be highly satisfactory and economical to all concerned, while at the same time the dangerous, annoying and objectionable overhead system would be abolished.

In conclusion, I submit a preliminary sketch showing a brick lined underground subway 4 ft. wide by 4¼ ft. high, located inside the roadway, close to the curbing.

The total cost for the actual construction of this double subway on the ordinary macadam roadways would be $12 per lineal foot, and on permanently paved roadways $16 per lineal foot, to which, of course, would have to be added all the other large incidental expenses connected with the conversion of the present system into the new. If the subways were placed directly underneath the concrete walks, the cost of construction would be increased 25 per cent., and would still have to cross over roadways at all street intersections and in addition be a serious hindrance to pedestrian traffic during period of construction.

Your most obedient servant,
JOHN GALT, City Engineer.

VISIT TO THE CHAMBLY WORKS.

AT the special invitation of Mr. Rudolph Forget, president of the Royal Electric Company, a party, composed of the directors of the Royal Electric Company and their friends, paid a special visit to the Chambly Rapids power house on Saturday, Sept. 9th. A special train carried the party to Chambly Canton, where the power house is situated. Mr. W. H. Browne, the general manager, and Mr. P. G. Gossler, the engineer, showed the visitors through the power house and explained the machinery used in the generating of power. At present there are four huge generators in operation, having a capacity of 3,000 h.p. each, making a total in operation of 12,000 h.p. The ultimate capacity of the power house is calculated at 25,000 h.p. Mr. Browne explained to the visitors that the generators were the largest machines of the kind that had ever been built, even larger than the Niagara Falls machines, and he was especially proud of the fact that they had been made at the Royal Electric Company's works in Montreal. The many interesting features of the plant were explained to the visitors, and the extraordinary precaution which is taken against lighting storms was shown. The visitors were greatly impressed by the machinery and the perfection of all the arrangements.

Among the visitors was Mr. W. R. Eckart, of San Francisco, the representative of the Blue Lakes & San Francisco Electrical Company, which is putting in a plant to supply power from the Blue Lakes, in the State of Nevada, to San Francisco, California, a distance of 150 miles, at a pressure of 60,000 volts, the highest voltage ever attempted and the longest distance transmission in the world. The machinery for this has been ordered from the Stanley Electrical Manufacturing Company, of Pittsfield, Mass., the associate company of the Royal Electric Company, Montreal, and a special object of Mr. Eckart's visit to Chambly was to inspect the machinery. He expressed himself as much impressed with the perfection and completeness of the machinery and arrangements.

The longest distance transmission in Canada is that of the Cataract Power Company, of Hamilton, being 37 miles from the generator to the motor, and the above mentioned plant from the Blue Lakes to San Francisco is the longest and highest voltage in commercial operation in the world. These facts are a strong testimonial to the efficiency of Stanley apparatus for the transmission of power over long distances.

SPARKS.

Early in October the British Columbia Electric Railway Company will commence the construction of a tramway line from Victoria to the Gorge, about two miles distant.

The Ottawa Electric Street Railway Co. have just let the contract to Messrs. Henney & Smith for the construction of a branch line to Britannia, a distance of about five miles. The contract price is $40,000, the company furnishing the rails, poles and ties. The road will be double tracked for the entire length.

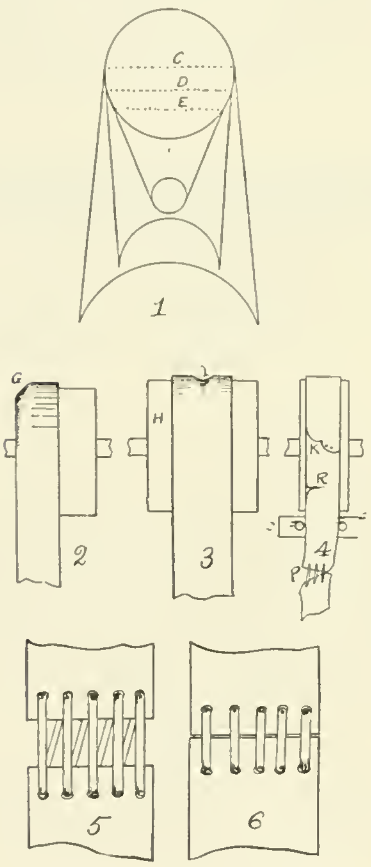
Mr. N. Pinze, of Montreal, has invented a new street car fender, which is to be tested by the Montreal Street Railway Company. The new fender is made of slats of iron or wood fitted on to a frame, which is attached to the front of the car. The slats are concave in shape, but the edge above the track is oblique instead of straight. By an ingenious contrivance the motorman can, when he sees any one on the track in front of him, drop the fender edge upon the track so that its oblique edge will only be a fraction of an inch from the ground. The outside end of the fender is supplied with small wheels or rollers which rest upon the rails and prevent the fender from forming an obstruction to the forward motion of the car by coming in contact with the ground. In addition, the new fender is supplied with springs which relieve the shock of the blow inflicted by a body coming in contact with the fender when the car is in motion.

ENGINEERING and MECHANICS

LUBRICATION OF LEATHER BELTS.

THE consumption of oils and greases for the lubrication of leather belts is much larger than many suppose. There are, of course, a number of special belting compounds which are used for the dressing of leather belts; but most of the manufacturing plants and power consumers adhere to the old way of caring for the belts, which consists in cleaning them at intervals with grease and oil, tallow or the like, then allowing the belts to stand until the lubricants have been absorbed. Belts which are run in dye houses, bleacheries, steam laundries and places were the air is moist do not get dry enough to require lubrication. But belting in wood working, metal working, shoe manufacturing, flour and similar establishments is more or less subjected to the dry, dust-laden atmosphere of the rooms, and in time becomes harsh, dry and stiff.

A little oil, grease or similar substance may be used to advantage in restoring the pliability of the leather. The trouble is that some men use too much of the lubricant. If the oil or grease is flowed all over belt and is not given time to impregnate the fibre, the belt will lose its grip on the pulley, and quickly run off. If, however, the softening stuffs are uniformly and lightly applied and given time to saturate the leather, the fiber will gradually assume a softer and more pliable condition, which will improve the driving qualities of the belt and avoid slipping.



LUBRICATION OF LEATHER BELTS.

But it is not always lack of a lubricant that causes a belt to slip and run to one side. If a belt is so arranged as to take in but a portion of the pulley, like C, Fig. 1, then much of the arc of contact is lost and the belt will slip with a load, even if the leather is properly lubricated. If the arc of contact is increased to that of D, a fuller grip is obtained of the contacting surfaces, and the belt will not be so likely to slip if it is properly limbered up with the right lubricants. If the arc of contact is brought to F, the bite is still more increased, and the danger of slipping averted, other conditions being right.

The most effectively lubricated leather belts will run to one side if the wheels are incorrectly set. This is illustrated in Fig. 2, in which a sample is given for the condition in which the writer finds very many pulleys. For some reason the local machinists are quick to decide that the belt itself, the lubricants, or anything but the pulley itself, is wrong. The tendency for a belt is to run to the high side of a pulley, except in case where the belt pulls down on the pulley, as in Fig. 2, when the belt rides the lowest edge at G. There is but one remedy, and that is to line up the shafting on which the pulley runs. Then the belt will take the centre of the wheel.

In Fig. 3 is a common case. A tight and loose pulley run together, and the belt shifter is adjusted so that but a fraction of the belt runs on the tight pulley. The result is that the belt constantly slips. Lubrication will not help it. Procure a monkey wrench and set over the belt shifter so that the full width of the belt will run on the tight pulley, and the difficulty will be overcome. Or if the tight and lose pulleys are set so as to permit a space to exist between, the belt will sink down as at I, and, of course, produce slippage.

If the tendency is for the belt to take a side of the wheel, Fig. 4, out of line with the guide pins J of the shifter, much trouble will result. The strain coming on that side of the belt, the edge will be broken as at R and K, and probably the joint opened as at P. The remedy again is to level up the shaft and pulley.

Again, it may happen that a correctly adjusted belt and freely lubricated one slips at certain points. Then examine the splices. If the jointing of the belt is open, like that in Fig. 5, it may be seen that the slipping occurs here when the lace leather is riding the wheels. The only remedy is to draw up the lacings and close the butts of the belt, as in Fig. 6.—American Miller.

QUESTIONS ON STEAM ENGINE OPERATION.

A writer in Modern Machinery asks the following questions: 1. How shall I proceed in order to equalize the load on the two pistons of my compound engine, 16 and 30 inches in diameter respectively? At present the high pressure piston does much more work than the low pressure and I wish to remedy the evil. 2. What is meant by re-evaporation in the cylinder of a steam engine? 3. Is it a source of gain or loss in economy? 4. How can it be prevented?

The answers given are as follows: 1. If you have an adjustable cut-off on your low pressure valve gear, shorten up the point of cut-off. This will increase the back pressure on the high-pressure piston, and raise the initial pressure on the low pressure, thus giving more expansion and a better distribution of the steam. If you have no cut-off on the low pressure valve-gear, or if it is not adjustable and you cannot have it made so, lower your boiler pressure and carefully note the effect. This will raise the terminal pressure in the high pressure cylinder, and send more steam to the low pressure? 2. There is always more or less water in the cylinder when running, either from a boiler that furnishes wet steam, from a steam pipe that is not well protected, or on account of initial condensation. After the cut-off has taken place the pressure falls rapidly, and if it is very low near the end of the stroke it so reduces the boiling point that the heat in the walls of the cylinder causes it to evaporate into steam again, but too late to be of any service? 3. It is a source of loss, because it takes heat from the cylinder without producing steam in time to be of value. The result is that when another charge is admitted, some of it is condensed, and this loss frequently is heavy, although often unsuspected by engineers. 4. Measures should be taken to furnish the cylinder with dry steam, it should be well lagged to prevent condensation, and as the pressure cannot fall too low unless the load is light and the cut-off short accordingly, the boiler pressure should be reduced until the terminal pressure is raised. If this is not practical on account of the necessity of maintaining a high pressure for other purposes, a reducing valve may be placed in the steam pipe. These changes will also increase the economy by reducing the loss from other sources.

The District Assembly No. 18, Knights of Labor, Montreal, at a recent meeting, discussed the advisability of petitioning the government to appoint experts to examine electrical plants, it being claimed that accidents resulting in loss of life and limb had taken place through the neglect of the government in not appointing an inspector for this purpose.

ENGINEERING NOTES.

The temperature of water in a boiler is the same as the temperature of the steam. Water cannot be heated higher than 212 degrees in the open air because it evaporates at that point; but in a closed vessel such as a boiler where there is pressure this tends to retard the boiling and the temperature of the water is always the same as that of steam.

WATER HAMMER.—If steam be admitted at the top of a vessel partially filled with cold water, condensation will take place until the surface is somewhat heated, and this, in connection with a cloud which forms above the surface, will retard rapid condensation, so that in due time the full steam pressure can be maintained above water cold at the bottom. This phenomenon is not an infrequent occurrence in boilers in which the circulation is defective. It is therefore perfectly safe to heat up any vessels containing cold water, if the steam can be admitted from the top upon the surface of the water and so maintained.

OIL TESTING. A home-made oil tester for a shop consists of a shaft and balls with a shell between. The whole rests in half bearings, around which is put an iron strap, the tension being regulated by a set-bolt. The balls run in grooves. To test, apply the oil, run the shaft and if the bearing gives signs, upon cooling, that the lubricating oil is gumming, it is an indication that resins of similar body-giving substance have been used. Resin oil, if properly distilled, does not produce this clogging. These bearings form pretty good oil testers, and they are sometimes found where they will generate heat with one oil and not with another. Such a bearing will determine the special merits of a machine oil.

BELTING.—The ultimate strength of ordniary bark-tanned single leather belting varies from 3000 to 5000 pounds per square inch of cross section. The thickness of single belting varies from 3/16 inch to 5/16 inch, and from 3/8 to 5/8 inch for double belting, and by taking the mean thickness we get the breaking stresses from 750 to 1250 pounds per inch of width for single belts and 1500 to 2500 pounds for double belts. The safe working tension should never exceed one-fifth of the strength of the joint, which is about one-third the above values. From this we find that by taking 1/5 of 1/3 of the breaking stress, or 1/15, the working tensions are, for single belting, 50 to 80 pounds, and for double belting, 100 to 160 pounds. Belts will run with the minimum of attention for many years, if the tensions do not exceed 50 pounds for single and 80 pounds for double belts per inch of width.—From "Smokeless Heat," by General Engineering Company.

"Orillia," writing to Power, asks: What size wire should be used for field magnet coils and armature of a four-pole dynamo of a capacity of two or three 16-candle power lamps at 107 volts, and what size should the armature be? The answer given is as follows: A dynamo of two or three incandescent lamps capacity is not a practical machine. Machines of that size cost almost as much to build as a machine which will maintain eight or ten lamps. The smallest sized machine to be used as a dynamo that we would recommend would be one which would as a motor have a capacity of one-half horse power. Run as a dynamo such a machine would have an output of about seven lamps. The wire to be used on the armature would be No. 21 B. & S. gauge. The size of wire on the field would depend entirely upon the design of the machine, shape of the frame, dimensions and so on. A machine of ordinary design would probably require No. 24 or 25 wire in the field coils, but this is of course a mere hazard. The armature of such a machine should be about 3½ inches in diameter and 3½ inches long.

HIGH EFFICIENCY INCANDESCENT LAMP.

SOME time ago the startling news was published that Maxim, one of the pioneers in the invention of the incandescent lamp, had succeeded in improving the lamp so that there would be a saving of 25 per cent. in the number of watts required per candle. It now appears from London "Lightning" that not only has this efficiency been reached, but even exceeded, and that a factory for making these lamps at a rate of 6,000 a day—the largest factory of the kind in England—is in course of construction. The consumption of energy of these lamps is said to be only 2.8 to 3.0 watts per candle, as compared with 4 to 4.5 watts in the usual lamps. No further information is given at present, but more is promised soon.

It is rumored that negotiations are under way looking to the extension of the electric street railway at Moncton, N.B.

EXHIBITS AT TORONTO INDUSTRIAL FAIR.

NOTWITHSTANDING that manufacturers are far behind with orders, the exhibit this year in the Machinery Hall of the Toronto Industrial Exhibition was quite up to the average. A number of manufacturers of electrical and steam apparatus were represented, reference to whose exhibits will be found below. The Canadian General Electric Company welcomed many a visitor for the last time to their show-rooms on Front street, the company having since removed to new offices, fitted specially for their purposes, at No. 14 and 16 King street east.

Entering the Machinery Hall from the east, we found the Royal Electric Company occupying a large space. Their exhibit was made very attractive by several hundred incandescent lights arranged in festoons near the ceiling over the company's exhibit. In a space about 50 x 40 feet there were displayed several S.K.C. dynamos, a complete line of direct current motors and S.K.C. alternating current motors, car motors and controllers, transformers, arc and incandescent lamps, lightning arrestors, switches and volt meters, and, in fact, everything necessary for a most complete central station, whether for railway, lighting or power purposes. The exhibit was much admired by visitors generally, and was of great interest to persons connected with the electrical industry.

A 30 h.p. engine of the regular side crank type was exhibited by the Robb Engineering Company, of Amherst, N. S. It was direct connected to one of the United Electric Co's dynamos. The diameter of the engine cylinder was given as 8", stroke 10", and speed 325 revolutions per minute.

The exhibit of the United Electric Company, of Toronto, consisted of one 45 k.w. inductor alternator, built for Bedford, Que., and one direct current, direct driven multipolar dynamo, driven by a Robb engine, built for the McLachlan Carriage Co., of Oshawa. There were also several steel multipolar motors of the enclosed type, designed for direct connection to all classes of machines and mechanical tools. Besides the above, there were shown arc lamps for direct and alternating circuits, arc dynamos, bipolar motors, transformers, etc.

In the Machinery Hall the Goldie & McCulloch Co., Limited, of Galt, Ont., were among the largest exhibitors. Their machinery included one large "Wheelock" engine, which, by the way, was sold to the Toronto Fair Association, and one 10 x 10 and one 12 x 12 Ideal nigh speed engine. These latter are of handsome design and finish, very compact and take up very little room, and are suited for either direct connection or belted drive dynamo. Their four gas and gasoline engines attracted much attention, one of these being directly connected to a triple pump. These engines are meeting with a large sale. There was also exhibited a number of wood-working pulleys and wood split pulleys and a gyrator, this latter being a flour milling machine of which this firm is the sole Canadian maker. Altogether, this exhibit was greatly admired by machinery men visiting the exhibition.

A display of gas and gasoline engines was made by the Northey Manufacturing Company, of Toronto. The little "Northey Junior" gasoline engine attracted much attention, it being adapted for the lighter work about a farm, etc. A 5 h.p. horizontal gasoline engine was used to run a Fleury 10 inch plate grinder, and during the Fair repeatedly ground 40 bushels of oats per hour, which is regarded as a good performance. This engine was not using its full power at any time when running the grinder, as it was also used for operating a feed cutter with pneumatic elevator, and did the work put upon it with great ease and regularity. Then there were 3 h.p. and 12 h.p. engines. The latter was operating one of the Northey Co.'s large triplex pumping engines, thus affording a good example of what a modern waterworks plant might be. The engine and pump together were shown to be extremely compact, and the absence of firing, handling of coal, smoke, dirt and ashes were very noticeable. These engines are also used for running dynamos direct for the lighting of gentlemen's residences and for other isolated plants. The manufacturers claim that they are the only engines built in Canada which will do direct work on a dynamo successfully, others having to use a storage battery between engine and lights.

The exhibit of the Electrical Construction Company, of London, was very instructive to those interested in the important details of construction of electrical apparatus, they having the parts of machines on exhibition showing the detail of construction and high class workmanship of their apparatus. Their slow speed motor, 12 h.p., running at 250 r.p.m., showed to advantage the adaptability of their motors for direct connection to printing presses and other slow speed machinery under direct electric control of the operator. Their 300-light dynamo, at 500 r.p.m., introduced a class of machines which, owing to their slow speed, cool and sparkless operation, bring forward to particular prominence the life of the dynamo, which is claimed to be almost without limit under these conditions.

TELEGRAPH and TELEPHONE

WIRELESS TELEGRAPHY FOR MARINE PURPOSES.

Mr. F. A. Hamilton, M.I.E.E., M.Can.Soc.C.E., contributes to the Halifax Echo a long letter on the value of wireless telegraphy for naval, military and shipping purposes, and more particularly in connection with the marine interests of the world. Concerning its employment in the latter sphere he says :

"Without soaring in imaginative flight to the realms of speculation and rambling conjecture, let us at once proceed to consider, in a matter-of-fact way, the actual work which this young and promising ariel has accomplished, and what he is ready and eager to perform at the present moment. By means of this messenger a moving object can be kept in telegraphic communication with any other moving object or a fixed station. A ship fitted with the apparatus cannot only keep in telegraphic communication with the shore up to any reasonable distance—it has been long since thoroughly tested up to over 30 miles off the shore—but ships can also, if thoroughly equipped, be warned of approaching danger or their proximity to dangerous coasts where the signalling appliances are placed. Fog, rain, snow and wind in no way impair the efficiency of this system of telegraphy, and herein lies its especial value for marine signalling."

Mr. Hamilton then takes as an example the case of an ocean steamer bound from a home port to one on our own shores, and shows how, having put to sea under conditions of drizzly weather and freshening wind, she can, by means of the telegraph system, communicate with passing ships and, if need be, give to an incoming vessel the bearing of and distance of the lighthouse or headland she has left behind her.

As showing the field for the employment of wireless telegraphy off the Atlantic seaboard of Nova Scotia, Mr. Hamilton says : "Between Seal Island and Cape Race there are several important lighthouses—including those on Sable Island—which might, with very great advantage to shipping, be provided with the means of signalling to a distance of thirty miles, or a less distance if desirable ; and likewise on the Labrador coast, in the Straits of Belle Isle and in the Gulf of St. Lawrence, where navigation is at times both difficult and dangerous. The establishment of such facilities would be a boon to commerce and a credit to the country, to say nothing of the possibility of its being made a source of revenue, or at any rate self-supporting. There are, of course, details to be considered in connection with such a scheme, such as making some stations signal stations only—that is to say, they would simply and automatically signal their number or designation—whilst other stations would be equipped for telegraphic communication. Then, again, it might be necessary in some instances to project the signals over a prescribed number of degrees, as, for instance, near the approaches to a harbor, in which case two stations might emit signals over a certain arc, so as to render it possible for a vessel to get a cross-bearing and establish her position."

Then Mr. Hamilton concludes: "The system has been in practical use in the Italian navy for over two years, and for several months has been the means of communication between the South Goodwin lightship and the South Foreland lighthouse, in the Straits of Dover. Telegraphic messages have been exchanged between stations on the coasts of England and France, and communication with passing vessels established. An interesting feature in the experiments is the facility with which Mr. Marconi succeeds in cutting out a third station so that it cannot interfere with the other two. The advances made in the application of wireless telegraphy to practical work have been such as to justify the belief that it will become a sine qua non to every coast and to all classes of vessels, whether on the ocean or in the great lakes."

Mr. H. W. Kent, general superintendent of the New Westminster & Burrard Inlet Telephone Co., is at present on a visit to his home in Peterboro', Ont. It is Mr. Kent's intention to visit Chicago, Cleveland, Toronto, Montreal and other cities for the purpose of inspecting the latest telephone switch-boards and appliances in existence, with a view to adopting the most improved system in the Vancouver Exchange. At present there are on the Vancouver Exchange over 800 subscribers, and the business has grown to such an extent that a switch-board of increased capacity has become a necessity.

SHORT CIRCUITS.

Mr. B. H. Turner will probably introduce a local telephone system at Manitowaning, Ont.

The Hudson Bay Co. are about to establish telephone connection from Fort Smith to Smith Landing, a distance of 160 miles on the Great Slave river.

The Department of Public Works at Ottawa invites tenders up to October 5th for the supply of 165 tons of galvanized iron telegraph wire for the Lake Bennett-Dawson line.

Mr. E. A. Dempster, chief clerk in the Great North-Western Telegraph Company's office at Hamilton, has been moved to Fort William, to accept a responsible position with the Canadian Pacific Railway Company.

The Columbia Telephone & Telegraph Co. is about to construct 50 miles of private telephone lines, extending from Grand Forks, B. C., to the various mines in the vicinity. An order has been given by Mr. J. P. Graves.

Ora P. King, Fred Bonnell, D. H. McNuit and R. B. Harmer are seeking incorporation as the Sussex and Hammond Telephone Co. They purpose erecting a telephone line this fall from Sussex to Jeffries' Corner, N. B., and will extend it to other points later on.

The Bell Telephone Company are making a number of extensions and improvements to their lines along the south shore of the St. Lawrence. Underground conduits have been laid as far as the Victoria Bridge, Montreal, and it is expected to have the line to St. Lambert completed in a short time.

The Dominion government has just let the contract to X. Gendreau, of Quebec, for the extension of the telegraph system from Big Roumaine, Que., to Chateau Bay, Labrador, opposite Belle Isle. The length of line to be constructed is 315 miles. The poles will be supplied by C. J. Bickerdike, of Montreal.

The annual general meeting of the shareholders of the Great Northwestern Telegraph Company was held at the head office in Toronto on September 27th. The old Board of Directors and officers were re-elected, viz : President, H. P. Dwight, Toronto ; vice-president, Adam Brown, Hamilton ; directors, H. N. Baird, James Hedley, A. S. Irving, W. C. Matthews, Toronto ; Richard Fuller, Hamilton ; Hon. Wm. McDougall, Ottawa, and Chas. A. Tinker, New York ; secretary and auditor, Geo. D. Perry ; treasurer, Arthur Cox. The financial statements presented showed a marked improvement in the revenue of the company over the previous year, and it was stated that the outlook for the coming year was still more hopeful.

Mr. M. T. Quigley, manager of the C.P.R. telegraph office a Vancover, B. C., is authority for the statement that his company has made arrangements with the Dominion government for connection with the line now being built in the Yukon district. The system to be be adopted will be that of sending merchants' filing messages in the Vancouver offices of the companies doing business there, the latter to transmit them by special arrangements on all steamers going north. The idea is to have packages of messages go, say, every other day from Vancouver. At Skagway they will be placed upon the line to Bennett, and at the latter place will be transmitted to the line being built by the Dominion government and forwarded to Dawson.

Mr. Chas. Park has been engaged as teacher in Electricity and Steam Engineering at the Toronto Technical School. Mr. Park was one of the four students who took the electrical course at the School of Practical Science, Toronto, in the first year after its establishment. Under his direction it is expected that the electrical and steam engineering courses at the Technical School will become even more efficient than in the past.

Messrs. McManus, Lowe & McManus, Sydney, C. B., are installing for the Nova Scotia Steel & Iron Company, a complete electric lighting plant, consisting of one 75 k. w. S.K.C. two phase generator and a complete equipment of 60 alternating current enclosed arc lamps. This, we believe, is the first installation in Canada where an alternating current generator has its capacity entirely taken up with arc lamps alone, and speaks well for the future of alternating currect arc lamps and also of the progress being made along these lines. The entire plant was furnished by the Royal Electric Co., of Montreal.

TRADE NOTES.

The Robb Engineering Co., Amherst, N. S., are supplying the town of Neepawa, Man., with a steam plant for their new electric lighting system—a 100 h.p. compound engine and two 75 h.p. Mumford improved boilers.

The corporation of the city of Winnipeg, through its Water and Light Commissioners, have awarded the contract for their incandescent electric lighting plant to the Royal Electric Co., of Montreal, the plant to consist of a 60 k.w. S.K.C. two phase alternating generator, with the necessary transformers, etc. The order for the arc apparatus was placed with the Western Electric Co., of Chicago.

Over five thousand letter carriers visited Scranton, Pa., on Labor Day, and took part in a parade which preceded the business session of the tenth annual convention of the National Association of Letter Carriers. In honor of the occasion, the business houses of the city were handsomely decorated and electrical devices were freely used. The International Correspondence Schools had a large monogram, I. C. S., with letters composed of red, white and blue incandescent lamps, in front of their building, making a very fine display. This institution has over one hundred thousand students, and as its mail is handled by carriers in all parts of the country, they were much interested in inspecting the home office at Scranton. A constant stream of visitors went through the building and on Friday evening an informal reception was given the letter carriers. Hundreds of them visited the building and saw how the work of the largest school in the world is conducted. The instructors, text book writers, correspondents, bookkeepers and other employees were at their desks, and the printing department was also in operation. Over 500 people are employed in the building, which is one of the finest in the city, having been erected especially for the International Correspondence Schools at a cost of $250,000.

The United Electric Company, Limited, of Toronto, have been rushed with orders recently, necessitating the operation of their factory 13 hours per day for the last two months. The following are some of the recent sales of their apparatus: R. E. T. Pringle, Montreal, two 6 h.p., two 8 h.p., and one 2 h.p. motors; J. & G. H. Young, Montreal, one 6 h.p. motor; Dominion Bridge Co., Montreal, two 10 h.p. motors; Kootenay Electrical & Construction Co., Nelson, B. C., 10 k.w. generator direct connected; McEachern Heating & Ventilating Co., Galt, one 5 h.p. motor; McGregor & McIntyre, Toronto, one 8 h.p. motor; John Turner & Sons, Toronto, one 10 h.p. motor; B. V. Naylor, Nayor, Que., 5 k.w. dynamo; Bourque & Poulin, Ottawa, one 12 h.p. motor; Auburn Power Co., Peterboro, one 4 h.p. motor; Darling Bros., Montreal, one 6 h.p. and one 8 h.p. motors; Toronto Lithographing Co., Toronto, one 8 h.p. motor; Royal Mfg. Co., Toronto, one 10 h.p. motor; Crompton Corset Co., Toronto, one 6 h.p. motor; E. S. Stephenson, St. John, N. B., one 2 h.p., one 5 h.p., and one 4 h.p. motors; Rat Portage Lumber Co., Rat Portage, one 15 k.w. dynamo; Alex. Dobson, Beaverton, Ont., one 4 h.p. motor; J. W. Skinner, Mitchell, Ont., a 60 light dynamo; Goderich Organ Co., Goderich, a 100 light dynamo; Dominion Bridge Co., Montreal, 25 arc lamps; C. T. Young, Beaverton, one 2 h.p. motor; Miller Bros. & Toms, Montreal, two 8 h.p. motors; Northey Mfg. Co., Toronto, one 4 h.p. motor.

SPARKS.

Mr. Edward Campbell, electrician, of Toronto, died in St. Michael's hospital recently.

The ratepayers of Weston, Ont, have voted in favor of installing an electric plant, at a cost to the municipality of $7,000.

The Nova Scotia Electric Light Co., which purposes supplying light and power on a somewhat extensive scale, have engaged an engineer to report on various water powers. Their options include the head waters of the Gaspereau river and the Currell brook at Bridgetown. Mr. J. W. Beckwith, of Bridgetown, N. S., is interested.

Mr. F. A. Cheney, of St. Catharines, states that arrangements are completed for the extension of the road to Port Dalhousie, and an effort will be made to convert the existing twelve miles of road into an electric line this fall. It is expected that the passenger service will be run by electricity this fall, but the freight business will be operated by means of steam until next spring.

Again the council of the city of Ottawa are discussing municipal ownership of the electric plant for civic lighting. Two companies have now to be dealt with, the Ottawa Electric Company and the Metropolitan Company, the works of the latter being only under construction. The Ottawa Company has named the following figures as the value af their assets: Capital stock, fully paid up, $765,800; debentures, bearing interest at 5 per cent., $320,000; accounts owing, bills payable, etc., $155,940.41; total, $1,241,740.41. The general opinion is that municipal control of electric lighting in Ottawa is yet far distant.

MOONLIGHT SCHEDULE FOR OCTOBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 6.10	A.M. 3.50	9.40
2....	" 6.10	" 4.50	10.40
3....	" 6.10	" 5.00	10.50
4....	" 6.10	" 5.00	10.50
5....	" 6.10	" 5.00	10.50
6....	" 6.10	" 5.00	10.50
7....	" 6.10	" 5.00	10.50
8....	" 6.30	" 5.00	10.30
9....	" 7.30	" 5.00	9.30
10....	" 8.30	" 5.00	8.30
11....	" 9.40	" 5.10	7.30
12....	" 10.40	" 5.10	6.30
13....	" 11.00	" 5.10	6.10
14....	"........	" 5.10	5.10
15....	A.M. 12.00	....	
16....	" 1.10	" 5.10	4.00
17 ...	" 2.20	" 5.10	2.50
18....	No Light.	No Light.	.....
19....	No Light.	No Light.	.....
20....	No Light.	No Light.	.....
21....	P.M. 5.40	P.M. 8.00	2.20
22....	" 5.40	" 8.50	3.10
23....	" 5.40	" 9.50	4.10
24....	" 5.40	" 10.50	5.10
25....	" 5.40	" 11.50	6.10
26....	" 5.30	A.M. 12.50	7.20
27....	" 5.30	" 1.00	7.30
28....	" 5.30	" 1.50	8.20
29....	" 5.30	" 2.40	9.10
30....	" 5.30	" 3.40	10.10
31....	" 5.30	" 4.40	11.10
		Total.........	209.50

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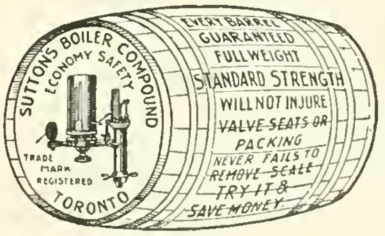

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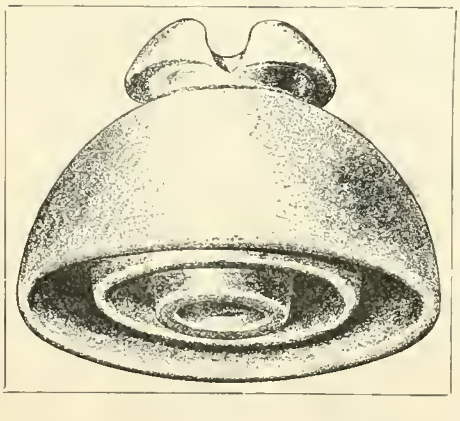

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Address all Correspondence to

C. S. Knowles

General Agent, 7 ARCH STREET, BOSTON, MASS.

SPARKS.

The electric light commissioners of Thorold, Ont., have been empowered to purchase a transformer.

The Coaticook Electric Light & Power Company, of Coaticook, Que., is now at work on a new power house on the old beet factory site.

Little Dorothy (greatly surprised at seeing a hoseless carriage go by), "My, there's a carriage that's walking in its sleep!"—Youth's Companion.

Mr. John E. Wilson, city electrican of St. John, N.B., has recommended improvements to the fire alarm system, at an estimated cost of $7,000.

A stationary engineers' association has been organized at Regina, N. W. T. Geo. Cook is president, T. S. Hiscox secretary, and P. Gilchrist treasurer.

The present contract for electric lighting in Midland, Ont., expires at the end of this year, and the question of renewal will be taken up at an early council meeting.

The Kay Electric Company, Hamilton, is about to be wound up. At a recent meeting of creditors the assets were shown to be $2,312.24 and the liabilities $1,721.03.

"I wish to see some of the current magazines, please." "Current magazines? Certainly. John, show this lady the Electric Spark and the Storage Battery." Ex.

The Stratford Electric Light Company are erecting a smoke stack 100 feet high and 14 feet at the base. It is not improbable that another boiler will be installed in the near future.

The Ottawa Power Company has been formed, with a capitalization of $250,000. The members thereof are W. C. Perkins, A. W. Fraser, M. C. Edey, J. R. Armstrong and John Fraser.

Wm. Brown McLean, B. A. Sc., of McGill University, Montreal, has been awarded a science research scholarship of £150 a year, tenable for two years, by the London Exhibition of 1851.

The J. H. Ashdown Mfg. Company, of Winnipeg, have purchased from the Electrical Construction Company, of London, Ont., one of their 500 volt, slow speed, multipolar 10 h.p. motors.

Thomas Hocking, F. W. Drake, John Henry McIntyre, Wm. McLandress and J. B. Crawford, of Dutton, Ont., have been incorporated as the Dutton Electric Light Company, with a capital of $15,000.

The Cataract Power Company have made a proposition to the council of Hamilton to operate the sewage interception works by electricity. Another offer has also been made to pump the city's water supply.

Mr. Geo. C. Robb, inspector for the Boiler Inspection and Insurance Company, of Toronto, has inspected the boilers in the various fire stations in the city of Ottawa, and has recommended that some of them be replaced by new boilers.

The Sturgeon Falls Pulp Co., of Sturgeon Falls, Ont., has asked the town for another bonus of $12,000, in return for which they agree, among other things, to renew the electric lighting contract for a term of 21 years, and to install a telephone system.

The Electrical Construction Company, of London, Ont., have recently closed with the E. Girardot Wine Company, of Sandwich, Ont., for a new 6 h.p. motor. This company have had one of the same motors for the last five years, and express themselves eminently satified with it.

The Brantford Electric & Operating Company, Brantford, Ont., are rapidly increasing their power business. The Keys, Somerville Printing Co. have installed a 3 h.p., two phase S.K.C. induction motor with which to operate their new printing presses. This is the second printing establishment that has put in alternating motors.

The Electrical Construction Company, of London, Ont., in their recent deal with the Winnipeg Street Railway Company for the exchanging of 500 volt motors for the 250 volt system previously in operation there, will have in the course of a few days 80 second hand motors of all sizes, which they will be able to place on the market at very reasonable figures.

The Electric Maintenance and Construction Co., of Toronto, Limited, advise us that they are extremely busy with contracts outside of house wiring and the Orillia contract. They have several large jobs on hand, including the contract for the entire installation of the electric lighting plant for the Gerhard Heintzman Piano Co., Toronto, this being a plant of 250 lights, with 20 k.w. generator, switchboard, etc., complete. It is proposed to use a Canadian General Electric dynamo.

The St. Catharines Cold Storage & Forwarding Co., Limited, are replacing their direct current power service in use in their warehouse with a 15 h.p., two phase S.K.C. induction motor. The current for this machine is supplied by the St. Catharines Electric Light & Power Co., who have recently installed in their power house a 200 kilowatt two phase S.K.C. generator for both lighting and power purposes.

Messrs. Brewder & McNaughton, contractors for the power canal of the Metropolitan Electric Company of Ottawa, have thrown up the contract, for the reason, it is said, that they tendered too low. It is the intention of the directors of the Metropolitan Company to complete the work themselves, a large number of men being now at work, under the direction of the chief engineer, Mr. Aylen.

The Electrician, of London, Eng., publishes a short description of the Desaymar lamp. The principle of it is that the filament is wound in the form of a coil around a specially prepared cylinder of a body which is brought to incandescence, apparently from the heat of the filament. The lamp is said to be brighter, and it is claimed that only half the energy is required to produce the same candle power, the saving therefore being about 50 per cent.

The Demarara Electric Company has been organized in Montreal, for the purpose of doing business in Demarara, West Indies. The franchises of the British Guina Light & Power Company and the Georgetown Tramway Company have been secured, and it is proposed to convert the latter system into an electric road. Engineers have completed the surveys. Messrs. W. B. Chapman, James Hutchison and B. V. Pearson are the provisional directors of the company.

At a recent meeting of the Vancouver city council, a letter was read from the secretary of the Board of Fire Underwriters, stating that that body had appointed Mr. A. K. Snelling to the position of electric wiring inspector, vice Mr. McMicking, resigned. The letter embodied a request that the council pass a by-law enforcing the inspection of electric wiring, the Board of Fire Underwriters to pay the inspector by fees, and the wiring to be done satisfactorily to that official. This was agreed to by the council.

At the last meeting of the council of Greenwood, B. C., the question of the extension of the electric light franchise was considered. Messrs. W. A. Campbell and J. McGregor have an option on the Boundary Falls for power purposes and the electric light franchise for the city. The latter expires on October 15th, and unless a steam plant is put in to generate power, it was stated that it would be impossible to complete the deal. The promoters agreed to put in a steam plant at once, although in a couple of months they expect to have their water power in operation.

A fatal accident occurred at Sherbrooke, Que., when a lineman named Benoit, employed by the Sherbrooke Gas & Water Company, was killed by coming in contact with a live wire. Another man named King was also rendered unconscious, but he will recover. The men in question were about to put up a lamp. They proceeded to lower the brace to which the lamp was attached, and not having a crank handy to work the small windlass on the pole, Benoit and King took hold of the windlass wire rope so as to undo the "dog." The former had both his hands on the wire, while King only used his right hand. Immediately King cried out, but so strong was the current that Benoit never spoke, and before assistance arrived he was dead, having received a current of 2,000 volts. His hands were burned to the bone, and the side of his face was badly scorched through coming in contact with the wire, in his struggle to free himself.

The Parry Sound Electric Light Co. held its annual meeting last month. The election of directors resulted as follows: S. Armstrong, J. F. Mosely, W. B. W. Armstrong, E. J. Vincent, Dr. Walton, Rev. W. Evans and John Clark. Mr. E. Pirie moved, seconded by J. F. Mosely, and carried unanimously, that we, the shareholders in the Parry Sound Electric Co., Limited, at the annual meeting assembled, desire to place on record the esteem in which we have always held our retiring manager and secretary-treasurer, Mr. W. B. W. Armstrong, and to express our confidence in his integrity and ability which he has so steadily displayed in the conduct and management of the company's affairs; and while we regret exceedingly that Mr. Armstrong has decided to sever his connection with this company, we heartily wish him every success in the profession he has decided to enter. The directors have elected Dr. Thos. S. Walton president; E. J. Vincent vice-president; J. H. Knifton auditor; and J. W. Easton secretary-treasurer and manager.

THE ELECTRIC PLANT OF THE MONTREAL COTTON COMPANY.

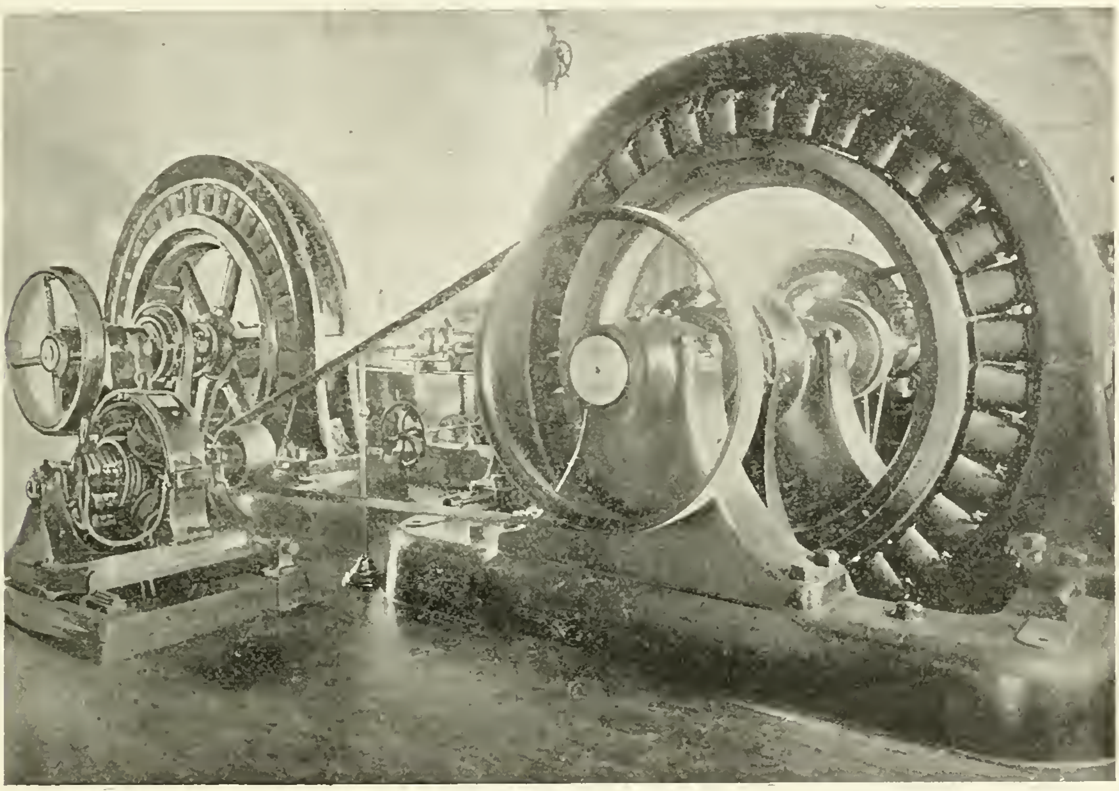
VISIT OF INSPECTION BY THE NEW ENGLAND COTTON MANUFACTURERS' ASSOCIATION.

ON October 5th and 6th the New England Cotton Manufacturers' Association assembled in convention at the Windsor Hotel in the city of Montreal. The forenoon of the second day was devoted to a trip to Valleyfield, upon invitation of the General Electric Company, of Schenectady, N.Y., the Canadian General Electric Company, of Toronto and Peterboro, and the Montreal Cotton Company, to inspect the extensive works of the latter company. The main object of the visit, however, was to view the magnificent power house and to witness the application of electric power for cotton manufacturing purposes.

A representative of the ELECTRICAL NEWS accompanied the party. At 9:00 o'clock a special train of five coaches, furnished by courtesy of the above named electric companies, pulled out of Bonaventure station, and about one hour and a half later the town of Valleyfield, some forty miles from Montreal, was reached. Going direct to the power house, the party was taken charge of by representatives of the General Electric Company and the Canadian General Electric Company, who explained the points of interest concerning the electric plant. Not a few of the cotton manufacturers from the Eastern States expressed surprise at the extensive character, efficiency and economy of operation of the plant, which is one of the most complete in every respect in Canada.

This plant was described in the ELECTRICAL NEWS of March, 1897, but since then important additions have been made, the total capacity of the power house being now taken up. Introductory to some brief details of the electric plant, and to give an understanding of the industrial application of the power, it might be stated that the works of the Montreal Cotton Company comprise eight large buildings, none less than three storeys in height and some reaching five storeys. The works are situated on Lake St. Francis, an expansion of the St. Lawrence, on a canal about twelve miles long, excavated by the Dominion government, a dam being constructed between an island and the mainland to maintain a sufficient supply of water in the canal. At this dam a head of fifteen feet at high water and eleven feet at low water is obtainable. For the cotton mills a head race has been excavated 1,000 feet long and tapering from 230 feet at the entrance to 165 feet wide at the exit, the walls being constructed of concrete faced with cement. By the arrangement of the head race the formation of anchor ice has been avoided.

In the power house, a substantial stone structure, 100 x 55 feet, with solid concrete foundation, there are two wheel-pits, each containing four McCormack 60 inch vertical turbines, making eight in all, built by the S. Morgan Smith Company, of York, Pa., each capable of developing 268 h.p. at 68 revolutions per minute under a 13 feet head. The turbines are directly coupled to four separate jack shafts, two wheels to each, placed in two rows extending the entire length of the power house. The wheels are governed by a Replogle's relay governor belted to each jack shaft.



MONTREAL COTTON COMPANY'S ELECTRIC PLANT.—TWO OF THE 400 K. W. GENERATORS.

THE ELECTRICAL EQUIPMENT.

Directly connected to four jack shafts are four generators of a capacity of 400 kilowatts at 600 volts, of the Canadian General Electric Company's well known three-phase 60-cyle alternating current type. Two of these generators are shown in the accompanying illustration, although it might be erroneously inferred from the illustration that the generators are not parallel in size. For field excitation two 4-pole 17 k.w. machines are belt connected to two of the four generator shafts.

The current is applied directly to the motors without the inter-

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RECENT PLANTS INSTALLED:—Lachine Rapids Hydraulic & Land Co., Montreal, Que., 12,000 h.p.; Chambly Manufacturing Co., Montreal, Que., 20,000 h.p.; West Kootenay Power & Light Co., Rossland, B.C., 3,000 h.p.; Dolgeville Electric Light & Power Co., Dolgeville, N.Y.; Honk Falls Power Co., Ellenville, N.Y.; Hudson River Power Transmission Co., Mechanicsville, N.Y.; Cataract Power Co., Hamilton, Ont.

CORRESPONDENCE SOLICITED.

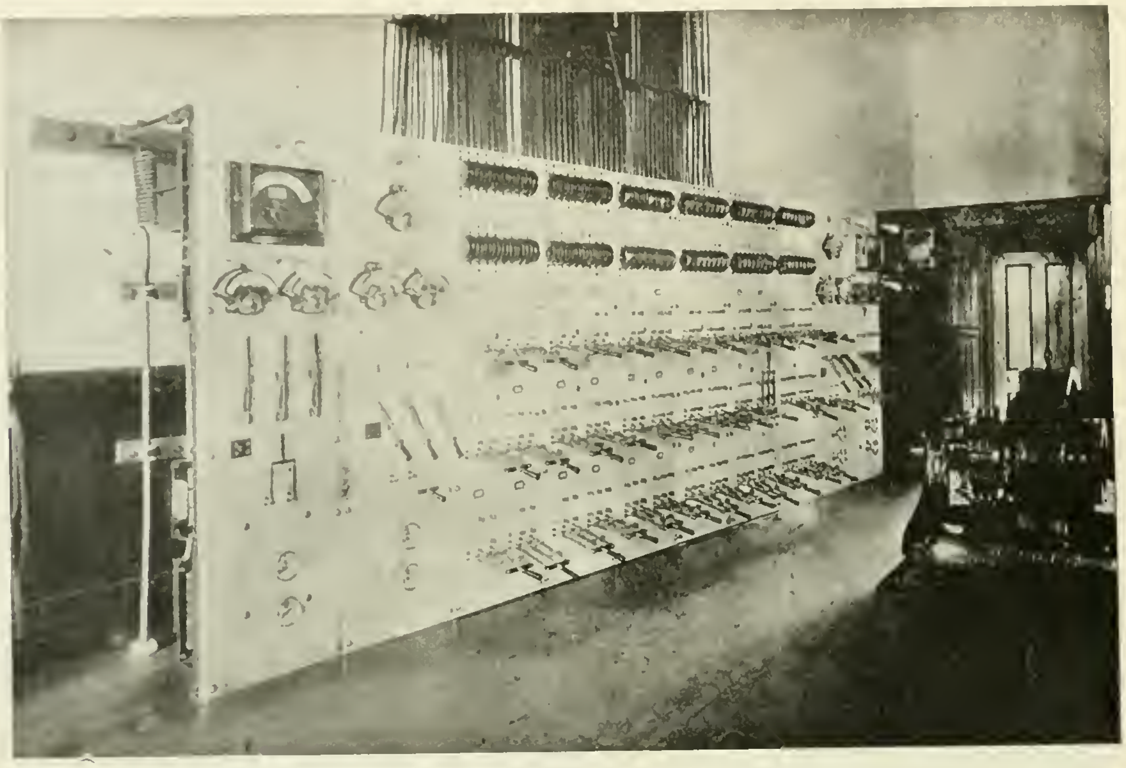
The Stilwell=Bierce & Smith=Vaile Co. = *DAYTON, OHIO. U. S. A*

position of transformers, and up to date there are about forty of these in use in sizes from 30 to 200 horse power, with several more in process of manufacture. The motors are of the induction type, self starting under all conditions of load, and without collector rings or brushes. At present about 2,300 horse power is utilized to drive electric motors and supply arc and incandescent lighting in all parts of the works. The majority of the motors, excepting those greater than 75 h.p., are suspended from the ceiling on solid supports, thus economizing floor space, and are belted to line shafting, doing away with the long belt drives previously necessary.

In a new mill just completed all the machinery will be operated by induction motors ranging in size up to 250 h.p.

SWITCHBOARD.

In one end of the power house is situated the switchboard, of which a view is shown. It consists of ten white marble panels mounted on an angle iron frame. The two outer panels at each end are the machines panels, each containing the necessary instruments and switches for operating the generators. From the remaining six panels the complete installation of motors and incandescent lights are controlled. If space permitted, more might be said of the interesting features of this switchboard.



MONTREAL COTTON COMPANY'S PLANT—GENERATOR AND FEEDER PANELS.

DIRECT CURRENT PLANT.

In another building is situated a direct current plant supplying a small portion of the lighting. There are seven Edison generators belt connected to a line shaft driven by a 54-inch vertical Hercules wheel, developing 165 h.p.

PROPOSED ADDITION.

Excavating was in progress for a large extension to the main power house, and it was learned that it is the intention to install two 1200 kilowatt Canadian General Electric three phase generators similar in type to those already installed. These will also be direct connected to McCormack turbines. For this increased installation the head race will be extended and two wheel pits constructed. An extension will also be built to the power house which will contain the switchboard. From this switchboard the entire installation throughout the works will be controlled.

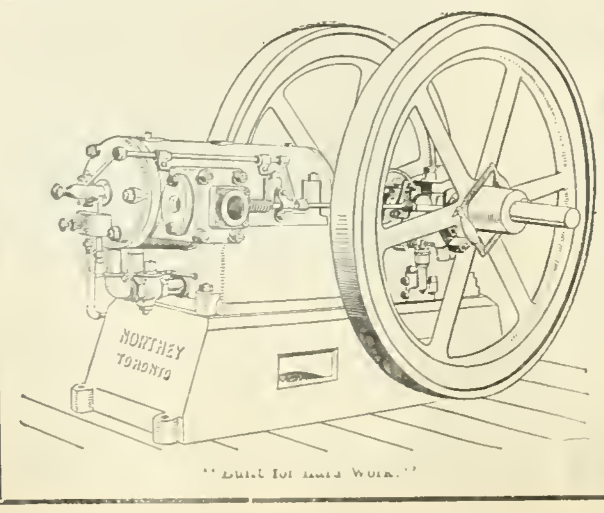
When completed this will be one of the most extensive electric industrial installations on the continent, having a total capacity of 5,400 horse power. The complete electrical apparatus was manufactured and supplied by the Canadian General Electric Company, of Toronto, to whom great credit is due. Prominent engineers have pronounced the use of electricity as applied at the Montreal Cotton Company's works to represent the foremost progress in electrical science.

After a cursory inspection of the manufacturing plant of the company the party were invited to partake of luncheon which had been provided in an adjoining building. About 1 o'clock the train was again taken for Montreal, after the thanks of the association had been tendered to the Montreal Cotton Company General Electric Company and the Canadian General Electric Company.

The Standard Chemical Company, of Deseronto, Ont., have recently installed an electric lighting plant in their factories. The apparatus was supplied by the Canadian General Electric Co.

The Canadian General Electric Company are installing one of their standard 120 kilowatt single phase alternators for A. Gagnon & Co., of Victoriaville, P.Q. This is the second machine of this size and type which this company have installed during the past year.

The Toronto Branch No. 1 of the Canadian Association of Stationary Engineers will hold their Thirteenth Annual Banquet at Webb's Parlours, Yonge and Melinda streets, Wednesday evening, October 18th (Thanksgiving Eve). Tickets $1.00; for sale by Committee, A. M. Wickins (chairman), Geo. Thompson (sec.-treas.), G. C. Mooring, J. Huggett, A. Stour, H. E. Terry, and any of the members.



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CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. IX. NOVEMBER, 1899 No. 11.

TWO-PHASE WATER POWER DEVELOPMENT AT SHERBROOKE, QUEBEC.

THE Magog river, its source in Lake Memphremagog, some thirty miles in length and situated high up in the Green Mountains of Vermont, flows in a northeasterly direction, crossing the border between the United States and Canada, finally joining the St. Francis river, one of the numerous tributaries of the St. Lawrence. At the junction of the two rivers Sherbrooke, a city of 12,000 inhabitants, is prettily situated, lying on the banks of both the Magog and St. Francis rivers.

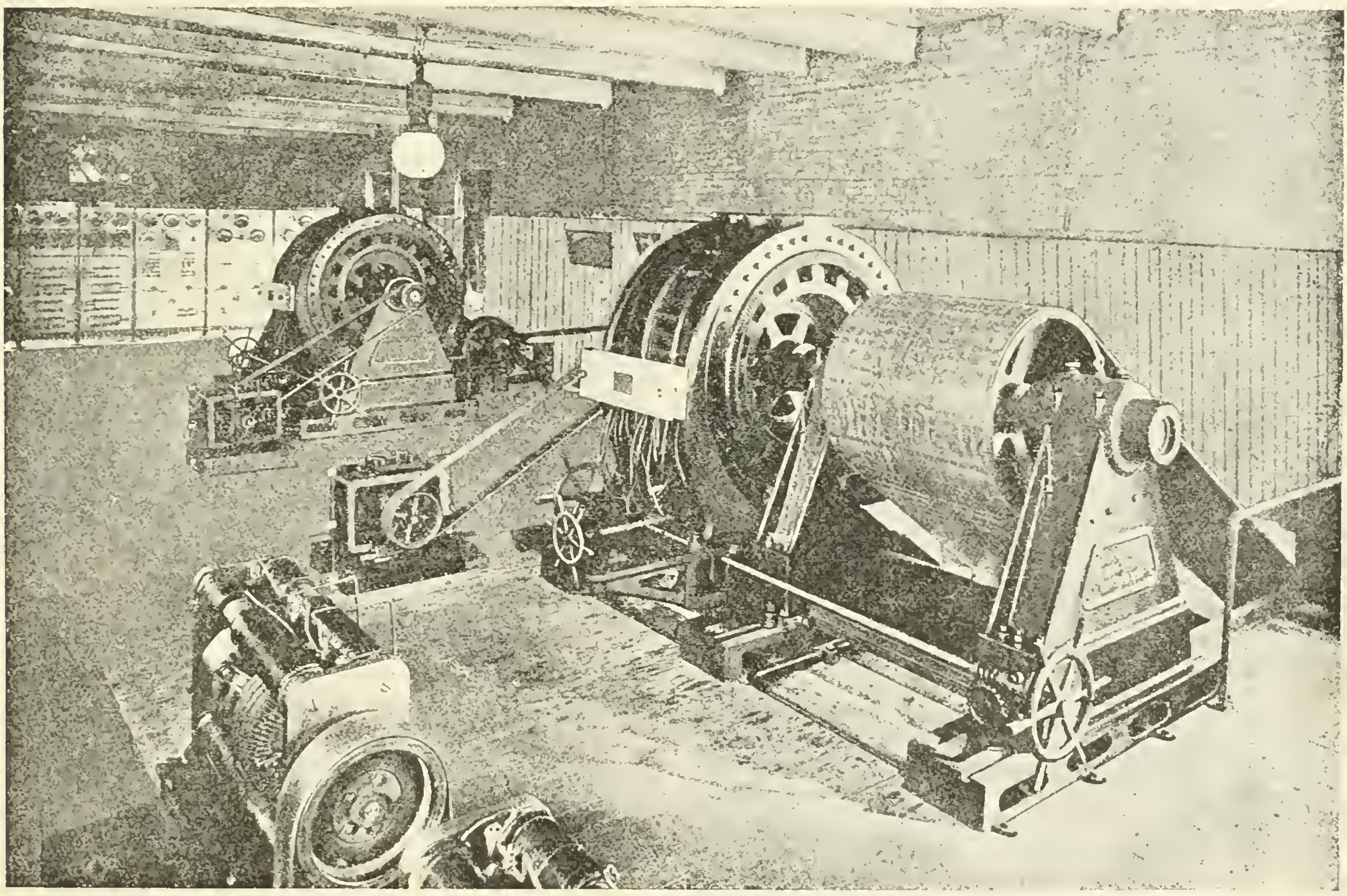


FIG. 1.—INTERIOR OF POWER HOUSE.

Within half a mile of this junction there is a gradual fall of 110 feet in the Magog, and as there is a plentiful supply of water throughout the entire year, this convenient and economical power is utilized to a great extent in supplying many industries, of which the principal are woolen, grist and saw mills, iron works, a carpet factory, the water works and the street railway and electric light plants. Though the head obtainable for each mill varies to a large extent, yet the average is about 24 feet.

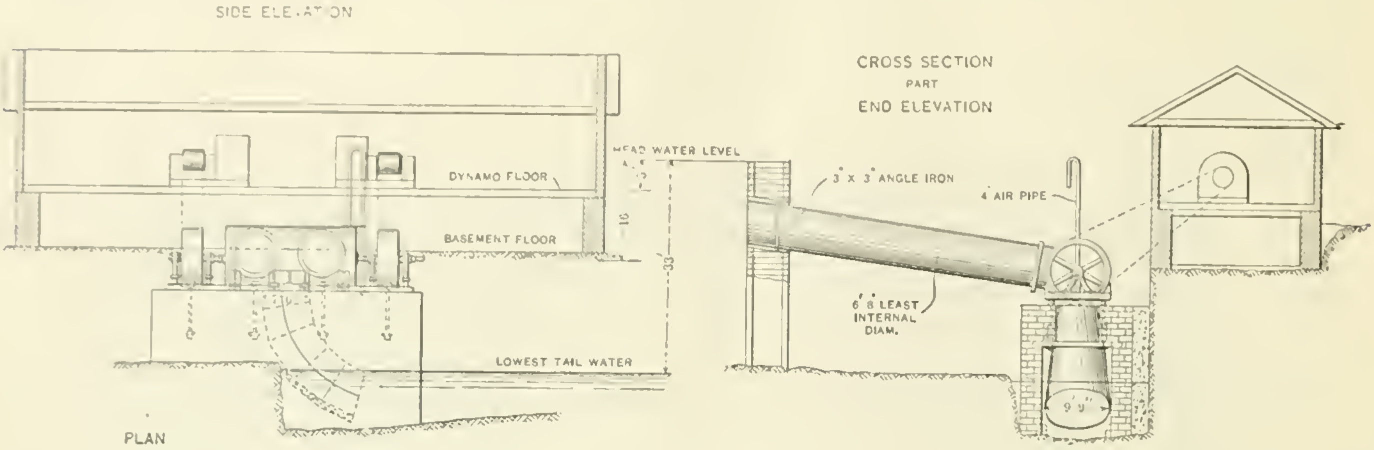
Though it might be profitable from an hydraulic standpoint to investigate the method employed by the various mills to develop the water power, we must content ourselves with a brief description of the electric light and power plant, its power development, its equipment and distribution.

This electric light plant, as it is still called, was installed in 1889 by the Sherbrooke Gas & Water Company, which at that time operated both the gas and water works, as its name implies, but which has since disposed of the latter to the city, still retaining the gas works, together with the electric plant. Here we find one of those rare cases where the gas and electrical interests do not conflict. In all the latest buildings being constructed the electric light is installed to the exclusion of gas, which is now, however, much used for heating purposes, taking to a great extent the place formerly occupied by the coal stove.

Since its inception the electric plant has undergone many changes. It first started with but a few lights run on the single-phase alternating current system. After increasing in common with all other similar plants, machine after machine being added when necessary, a radical change was made in 1897 by the adoption of the two-phase system using S.K.C. machines, which have been in operation ever since for both light and power with excellent results.

WATER POWER DEVELOPMENT.

One of the numerous small falls on the Magog has been utilized as a head for the power required. By reason of a natural dam extending across the river at this point between the two rocky cliffs composing the river banks, but a comparatively small outlay was necessary to control, store and utilize the otherwise wasted potential energy of the water.



The river flows through a narrow rocky gorge some 200 feet wide, the sides rising very abruptly, almost precipitously, from the river bed, which is nothing but solid rock. The natural rock dam extended almost entirely across the river at the point selected for the head race entrance, and all that was required was to erect a wing dam and thus direct the flow of the water and also to store it.

The inner side of the head race is the abrupt bank of the stream, some blasting being necessary for the removal of the projections and the large boulders to make it conform to the required conditions for service. The outer side is constructed entirely of timber, the main supports being 10 inch by 10 inch spruce faced with 3 inch plank on the inner side, which slopes diagonally into the head race such that the weight of the water itself provides the required stability. The form of this retaining wall is thus a right-angle triangle, the vertical side varying in height from 8 feet a the entrance to 3 feet at the extreme end of the head race, while the base varies correspondingly.

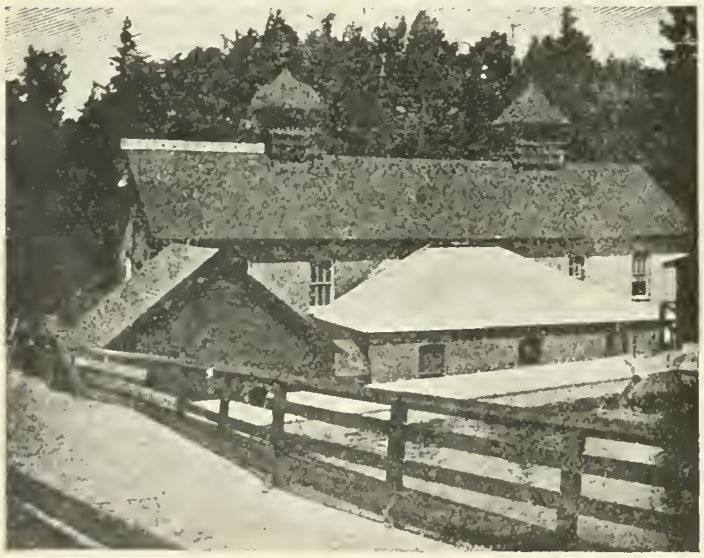


Fig. 2.—Power House.

The head race is 300 feet long and varies in width from 50 feet at the bulkheads to 150 feet at the entrance, the breadth of the river; in depth it is 5 feet at the entrance, increasing somewhat as the bulkheads at the far end are reached.

The velocity of water in the head race is 4 feet per second, and it is consequently never frozen over even during the most severe weather in winter. Strange to relate, no great difficulty has been experienced with either frazil or anchor ice, never yet necessitating the shutting down of the plant for a moment. There is, of course, a certain amount of frazil at times, as in all running water exposed to intense cold, but not enough to do any damage, and during severe weather men are always stationed at the two racks to prevent the accumulation of ice, slush or rubbish, which they remove with rakes through small waste gates in the side of the head race or over the sloping sides. There are two racks placed 100 feet apart in the head race to prevent ice of any description, logs or floating debris passing through to the wheels.

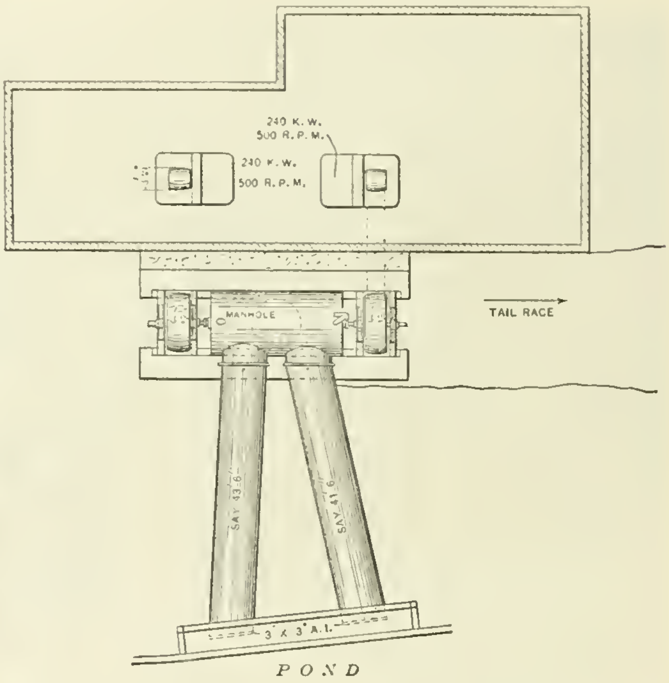


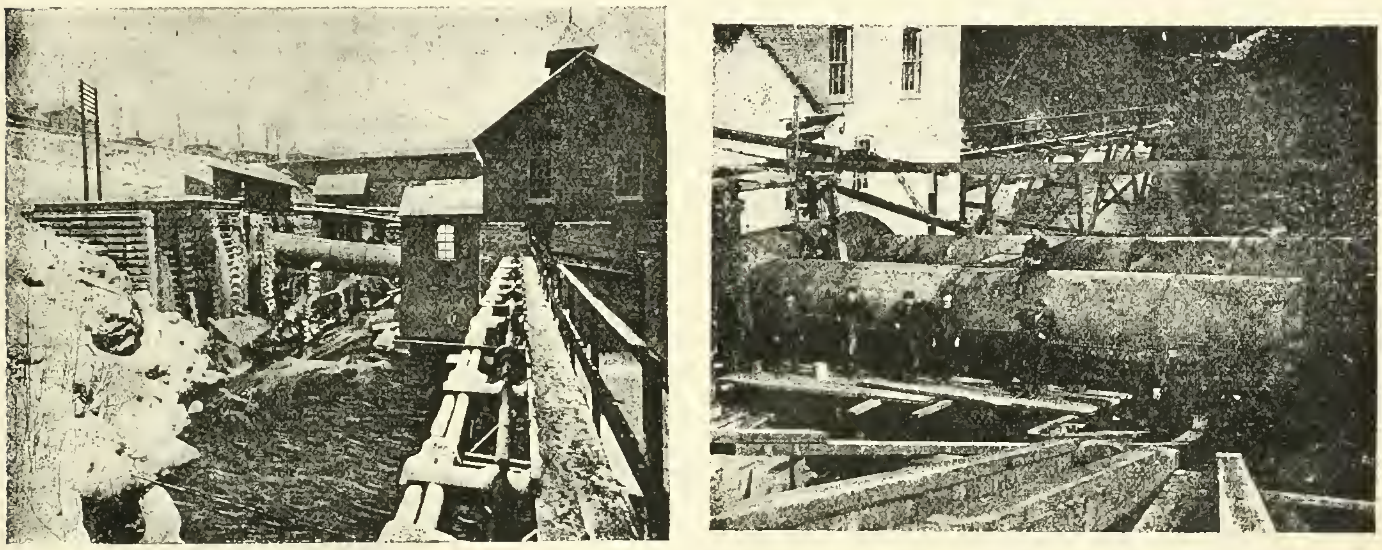
Fig. 3.—Plan, Elevation and Section of Power House.

Situated at the lower end of the head race are two gate houses serving as intakes or entrances to the three pipes or flumes carrying the water to their respective turbines in the power house. In each gate house there are wooden gates which may be closed when necessary to stop the flow of water in the flumes.

The first flume is a ¼ inch steel pipe 6 feet 6 inches in diameter, composed of 6 foot lengths securely riveted together; the whole flume from gate house, where there is a one-eighth turn elbow located, to the wheel case, to which it is riveted, is 50 feet long. The remaining two flumes are also ¼ inch steel, 6 feet 8 inches in diameter, 50 feet long, running side by side in a straight line to the wheel case situated in the power house. A view of this when under construction is shown in Fig. 4. The weight of these massive pipes is supported by two large masonry piers in which they are imbedded to about one-quarter of their diameter. Expansion or contraction is neglected, as it is inconsiderable in such a short length of pipe, besides which the water inside is flowing continually and the heating or cooling effect of the atmosphere on the pipe is thus reduced to a minimum.

TAIL RACE.

The tail race, a great portion of which has been blasted out of the solid rock, is directly beneath the bulkhead, and lying between it and the power house. A winter view of this and also the bulkhead and pipe line is shown in Fig. 5. It is 140 feet long and 40 feet wide, the discharge flowing away into the river, where it undergoes a similar process farther down, being utilized again and again for power purposes.



[Figs. 4 and 5—View of Tail Race and Flumes.

A wing dam constructed of rock and of the shale removed during the process of blasting separates the tail race from the river, and 5 feet higher than the level of the tail race, thus preventing it being submerged by the river even at high water.

The draft tube, 7 feet in diameter at the top, extends down vertically a few feet from the large wheel case, then gradually making a quarter turn, discharges into the tail race in the direction of flow, its diameter here being increased to 10 feet. A deep hole was excavated in the tail race to accommodate this huge pipe, keeping it continually submerged, so that no air could possibly enter to destroy the head produced by the vacuum due to the rapidly descending discharge water. The greatest available head is 34 feet, which is one very desirable for facility and economy of operation.

POWER HOUSE.

Nestling in the chasm between the precipitous banks of the river is a small rocky island, and here is the location of the power house, a one-storey brick building 80 feet long by 26 feet wide (Fig. 2). The foundations are of solid masonry resting on the bedrock.

The framework is of wood, the timbers being very massive; the floors are of very thick hardwood planking supported by wooden beams; the roof is also of planking, but is covered with iron sheathing.

The hydraulic equipment consists of three turbines, having a total capacity of 1,730 h.p. The first is a 54-inch "New American" vertical turbine capable of developing 535 h.p. at 124 r.p.m. under the normal head of 30 feet obtained at this point; this head may be increased at any time by carrying the tail race excavations further up, and so obtaining almost the whole 34 feet, which is used at the other wheels only some 20 feet away. This wheel was manufactured and supplied by Wm. Kennedy & Sons, Owen Sound, Ont., the Canadian agents and manufacturers for the Dayton Globe Iron Works Company, of Dayton, Ohio. From a horizontal pulley connected to the vertical turbine shaft by means of a mortise bevel gearing, a generator in the dynamo room is belted.

The remaining two are each 40-inch "Crocker" wheels of the horizontal type, both placed in one case, a huge steel cylinder, 10 feet in diameter and 22 feet long, fed by the two steel flumes (Fig. 1). Being inward flow turbines, the water enters at each end of the case, and rushing inwards towards the centre, strikes the wheel vanes, the thrust of each wheel being equalized by the other. Being then deprived of its energy, the water falls inert into the draft tube, and, descending vertically, discharges into the tail race. This draft tube has a vertical height of 17 feet above the tail race, and the head over the wheels is also 17 feet, thus producing an available head of 34 feet, at which each wheel is capable of developing 596 h.p. at 180 r.p.m. Two overhung pulleys, one at each end of the wheel case, supply power to two generators in the dynamo room by means of two immense leather belts; an adjustable belt tightener is used to take up all slack. A plan and elevation of the power house (Fig. 3) will show the above arrangement. The two "Crocker" wheels, with wheel case, steel flumes and draft tubes, were manufactured and installed by the Jenckes Machine Company, of Sherbrooke, Que.

The gates on all three wheels are of the "register" type, which, on opening or closing by some regulating device, control and adjust the quantity of water striking the vanes of each wheel. The regulating device, by means of which the gates are opened or closed according to the variation in the speed of the generator, is a "Replogle" electro-mechanical governor, manufactured at the Replogle Governor Works, Akron, O. There are two of these governors, one for each water wheel unit—one for the "New American" and the other for the two "Crocker" wheels, the gates of both wheels being operated to the same degree at the same instant, as both are in the same wheel case.

The electrical equipment consists of two 240 k.w. two-phase S.K.C. generators belted to the "Crocker" unit, one 180 k.w. two-phase S.K.C. generator and three 35-light "Ball" arc machines, all belted to the "New American" wheel.

The two largest machines (Fig. 1) are placed on concrete foundations 20 feet high resting on the bed rock beneath, and operate at 500 r.p.m., delivering current at a pressure of 2,400 volts direct to the line with a frequency of 133 cycles per second. The 180 k.w. two-phase generator has the same voltage and frequency, but is run slightly faster at 660 r.p.m.

Belted to the shaft of each of the three generators is an 8 k.w. 4-pole exciter, each of which is capable of fully exciting the entire plant.

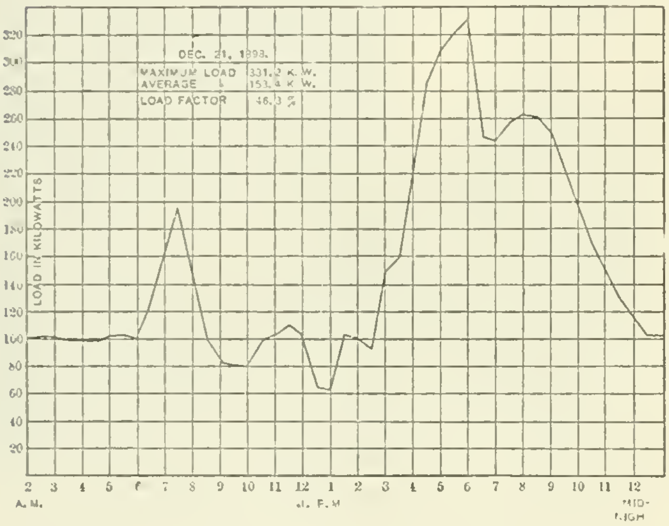


FIG. 6– LOAD CURVE, DEC. 21, 1898.

All the S.K.C. apparatus, generators, switchboard and instruments were manufactured and installed by the Royal Electric Company, of Montreal.

There are three 35-light arc machines, made by the Ball Electric Company, of Toronto, in use at present, but these will shortly be shut down and the present system of direct current series arc lighting changed to the enclosed alternating current arc lamp system run from constant current transformers, so that power, incandescent and street lighting will all be operated from one machine, thus making an ideal arrangement.

SWITCHBOARD.

The switchboard, a view of which may be seen in Fig. 2, consists of eight white marble panels mounted on a solid white oak frame, presenting a handsome appearance. It is situated at the end of the dynamo room.

The first three panels to the right are solely for the machines, while the remaining five are the distributing panels for the various feeders; each panel is one huge slab of Vermont white marble.

The machines are not operated in parallel, but are run separately, the load being divided between the machines in operation in proportion to their respective capacities.

The first three panels, which are the three generator panels, are similar to each other, except that the third contains an S.K.C. static ground detector and switch for connecting any line to ground, hence a description of one applies to all. Each machine panel contains the following apparatus in the order named, starting from the top of the board: A voltmeter, which, by means of a small switch placed underneath, reads the pressure on either phase; two ammeters, one in each phase; two double-pole high potential S.K.C. slide switches, one in each generator phase; two regulator heads, one in each phase; a double-pole, double-throw switch such that either of two exciters may be used to excite the field of any generator; and lastly, a generator and an exciter field rheostat. The regular heads in each phase act to vary the machine voltage by causing some small armature coils in the machine to act either in conjunction with or in opposition to the main armature coils, thus raising or lowering the voltage. For this purpose it is, of course, necessary to run the terminals of each coil to the regulator head on the switchboard, though in a small machine the regulator heads are placed on a terminal board on the machine itself. The maximum variation in the primary voltage obtained by means of this regulator head is 200 volts on each phase.

Each of the five feeder panels is but a repetition of the other, so that a description of one will suffice. The first two panels are for the incandescent lighting circuits only, while the remaining three panels are for combined light and power from the three-wire two-phase distribution used. Each of these panels, then, contains the following apparatus, viz.: Two ammeters, one in each phase or circuit; two S.K.C. circuit breakers, also one in each phase, and four double-pole double-throw switches such that any circuit on the lighting panels may be placed in either phase of either generator.

The indicating instruments are mostly of the Royal Electric Company's round type, though some few of the Whitney make are used.

DISTRIBUTION.

From the switchboard the various feeders pass through two cupolas in the roof to the poles, where current is then distributed in the city on the three-wire two-phase primary system, and transformed down to 104 volts for light and power service by means of transformers banked in as large units as may be economically used to supply all the customers in that immediate vicinity. The ordinary four-wire two-phase secondary distribution is used exclusively.

Though no lightning arresters nor choke coils are placed in the power house, there are no less than twenty sets of two S.K.C. non-arcing lightning arresters located at various points on the line, to which taps from the service wires are taken, the ground wire being No. 4 B. & S. As an extra precaution, a barbed wire is run along the top of the poles and grounded at every fifth pole in one section of the city.

There is a short transmission line to Lennoxville, a town of some 2,000 inhabitants, situated four miles away, where both light and power are supplied.

The poles for this line are similar to those used in the city, perhaps somewhat shorter, and are of white cedar, 35 feet long, 7 inches in diameter at the top, embedded 5 feet in the ground, and are spaced 100 feet apart.

The three-wire two-phase line consists of two No. 2

B. & S. and one No. 1 B. & S. weather proof insulated copper wires placed on double petticoat glass insulators, thirteen inches between wires. A transformer is used as a booster to raise the potential on this line a slight amount, such that the voltage at Lennoxville will be the same as in the city ; that is, the amount boosted will represent the line drop, which is in this case a very small amount.

This plant is in operation continually, suffering no interruptions. A load curve is shown in Fig. 6. There are some 6,500 16 c.p. incandescent lamps and about 150 h.p. in induction motors in various sizes installed, and, as previously stated, by the time this goes to print there will be a system of 100 enclosed alternating current arc lamps of the General Electric type for street lighting, supplied from the regular circuits by means of constant current transformers.

Current is sold both by meter and by the flat rate, some 300 meters being already installed. For incandescent lighting the rate is one-half cent per ampere hour, after deducting the usual discount allowed for prompt payment, a 3½-watt lamp being used. The flat rate is $6 per 16 c.p. lamp per year, with a sliding scale of prices for large consumers. For power the rate varies from $70 per h.p. year in small units to $30 per h.p. year for larger sizes, such as 30 h.p. and greater.

The officers of the Sherbrooke Gas & Water Company are : Mr. R. W. Heneker, president ; Mr. E. F. Waterhouse, secretary, and Mr. A. Sangster, electrical engineer and general superintendent.—E. M. Archibald, in Electrical World.

BY THE WAY.

WHAT is claimed to be the largest electric sign in Canada attracts the attention of passengers on the Grand Trunk west bound trains as they approach the little village of Acton, Ont. This sign stands on the coping of the factory and reads : "W. H. Storey & Son, Glove Manufacturers." It is over 50 feet from the ground and 100 feet in length. Each letter is three feet in height and of corresponding width, and 340 incandescent lamps, designed to give the most brilliant effect, are required to properly light it. The current is supplied by a dynamo on the premises, and the work of wiring and installing the lamps was done by Mr. Kitchen, electrician in charge of the municipal plant. The brilliancy of the sign is a splendid example of the usefulness of electricity for advertising purposes.

× × ×

SOME time ago trouble developed on the arc light circuit at the Union Station, Toronto. The electric light company's officials went carefully over the circuit and examined with the closest scrutiny every joint, without finding any defect which would account for the failure of the lamps to operate. While walking about the building with eyes alert to discover any clue which might assist to solve the mystery, the official's attention was attracted to the peculiar conduct of a man in the barber shop, who was gazing intently at the lamp overhead. In answer to a question as to the object of his interest, he replied that he had invented and was testing a new kind of arc light carbon, "and," he added enthusiastically, "I'm satisfied it will be a success." Here then was the solution of the mystery. The ingredients in the new style carbon were not of a kind to permit the passing of the current to the lamps beyond. In the absence of a stenographer there is no actual record of the language employed by the electric light official towards the enterprising inventor, but it is said to have been delivered at a very high voltage and not intended for publication.

ALUMINUM WIRES.

IN a recent comment on the proposed use of aluminum wires in connection with the electric transmission line from Ragged Rapids to Orillia, Ont., the fact was mentioned that in like manner in only one other instance was aluminum being similarly employed, viz., in the new transmission plant at Snoqualmie Falls, 31 miles distant from Seattle and 45 miles from Tacoma. From a description of this plant appearing in the Electrical World and Engineer, the following particulars are extracted regarding the transmission lines, for which aluminum wire is exclusively employed :

The transmission circuits are led from the transformer house over a rough but not mountanous country to a sub-station at Issaquah, 10 miles distant, the lines paralleling each other at a distance of 40 feet. These parallel lines continue to Ranton, a further 9 miles, where current is used locally, and from that point branch to the north-west and south-west to Seattle and Tacoma.

Aluminum wires have been used on these long distance transmission circuits of No. 1 and 2, B. & S. guage. Line conductors are spliced with the McIntyre joint, consisting of a flattened aluminum tube 9 inches long, with walls 1-16 inch thick, large enough to enclose two wires. The latter is given three complete twists by special clamping tools to complete the joint (Fig. 1). The Seattle line contains about 67,000 pounds of aluminum, and the Tacoma line 72,000 pounds, each line consisting of two three-phase circuits. The conductors are carried on triple-petticoat "Imperial" glazed porcelain insulators, 4½ inches high, 6½ inches in diameter, weighing 4 pounds each. Paraffined locust pins are used to support the lower part of the insulator 4 inches above the cross arms. The tie wires are of No. 3 aluminum.

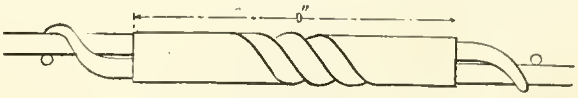


FIG. 1.—ALUMINUM WIRE JOINT.

Two circuits are run on each pole line, one on each side, with triangular space of 30 inches between wires (Fig. 2). Four wires on the lower cross arms are spaced on either side 25 inches and 75 inches from the centre of the pole ; 25½ inches above on another cross arm are two wires, 50 inches on either side of the pole. The length of span on the Seattle lines varies from 90 to 150 feet, with an average of 110 feet. On the Tacoma line the average span is 150 feet.

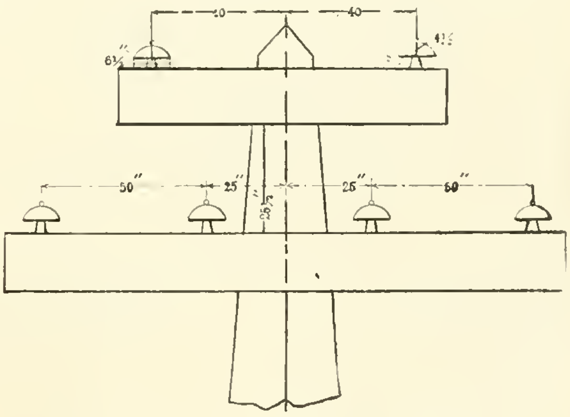


FIG. 2.—LOCATION OF CIRCUITS ON POLES.

The behavior of the new conducting material when this plant goes into operation will be watched with particular interest.

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ELECTRICAL NEWS
AND
ENGINEERING JOURNAL

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics legitimately coming within the scope of this journal

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The "Canadian Electrical News" has been appointed the official paper of the Canadian Electrical Association.

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A Nice Point in Law.

The courts will shortly be called to decide a fine point of law in connection with the appeal which has been filed by the Montreal Street Railway Company against the assessment which the city seeks to impose on the company's poles, wires and rails. The valuation for assessment purposes put upon this portion of the company's plant is $280,000. The assessment is made under article 361 of the City Charter. The company in their appeal have pointed out that, while authority is given, under the above mentioned article of the City Charter, to tax poles, wires and rails of the company, this article is a violation of article 567 of the charter which provides that the city shall not be allowed to violate any of its obligations undertaken by contract. The contract between the city and the company stipulates that a percentage of the earnings of the railway shall be paid to the city in lieu of taxes, except taxes on real estate. The company state that, in accordance with this provision, the city have accepted a percentage on the earnings of the company in lieu of all taxes and assessments, with the exception of the tax on immovable property which was immovable at the time of the making of the contract. The company express their willingness to pay taxes on their lands, buildings and machinery. The courts will be asked to decide the question.

The American Street Railway Association.

THE eighteenth annual convention of the American Street Railway Association, which opened in the city of Chicago on October 17th, was in some respects one of the most successful yet held. The attendance was unusually large, and while but four papers were presented, their reading and discussion brought out many interesting and suggestive points. A noticeable feature of the convention was the consideration given to the labor question and the method of manipulating employees. Mr. Vreeland characterized the question as one requiring a great deal of energy and ability, but which if satisfactorily handled was one of the greatest elements of strength in street railway management. An argument was advanced in favor of employing young married men. A question affecting street railway practice was brought up by Mr. Heft, who made the statement that in looking up the matter of weights he had found that for every passenger hauled with a modern street railway equipment 721 pounds of dead weight were also hauled, which is only 137 pounds less than the standard steam railroad equipment. It was pointed out that street railway managers might with advantage turn their attention to effecting a reduction in the weight of equipment. The respective merits of single versus double motor equipments formed an interesting discussion, the consensus of opinion being in favor of cars equipped with two or more motors. The objection to single motors was the greater cost for repairs and insufficient tractive power. "The Construction and Maintenance of Street Railway Tracks" was treated in a paper by Mr. Edward Butts. He advocated that the rail should be not less than six inches in depth, the rail trench 20 feet wide at the top and 6 inches wide at the bottom, and that cast-welded joints be used. This latter recommendation created considerable discussion, inasmuch as it is a comparatively new practice in street railway construction. Mr. Heidelburg, of Chicago, said that the Chicago

City Railway Company was the second company to use the cast-welded joints, and that they had given excellent satisfaction. It might be mentioned that the Montreal Street Railway Company have lately adopted this class of joints on a portion of their road, and that the directors have recommended that it be applied to the entire system. There was present at the convention the following representatives of Canadian street railways: J. B. Griffith, manager, and C. K. Green, director, Hamilton Street Railway Company; E. H. Keating, manager, Ewan Mackenzie, assistant superintendent, and P. McCullough, electrician, Toronto Street Railway Company; Duncan McDonald, superintendent, H. A. Brown, electrician, and W. A. Ross, comptroller, Montreal Street Railway Company.

Wireless Telegraphy.

THE employment of Mr. Marconi by the New York Herald and the Chicago Times Herald, to report, by means of wireless telegraphy, the recent International yacht race, has given a further demonstration of the practicability and value of this important discovery. By means of the Marconi system messages were transmitted from the vessel on the race course to the city of New York within periods of one-half to two minutes, to Chicago within seven minutes, and to London within fifteen minutes. In other words, the system effected a saving in time, as compared with dispatch boats, of fully an hour. On another page will be found a very clear and concise description of this system prepared for the New York Herald by Mr. Marconi's assistant, Mr. Broadfield. We are pleased to observe that the British Goverment are said to have arranged to make use of the Marconi system in connection with the war which is at present in progress in the Transvaal. It would appear that the system might there be employed to great advantage in view of probable interference on the part of the Boers with the telegraph system. Notice has recently been given in the press of an action which has been entered against Mr. Marconi by Professor A. E. Dolbear, of Tufts' College who claims to be the original discoverer of space telegraphy, and who is said to be in possession of broad patents covering the transmission of messages without wires. Professor Dolbear is not likely to receive much sympathy in connection with the step which he is said to have taken. If, as far back as 1885, he demonstrated the practicability of telegraphing without wires, has allowed the important discovery to remain unutilized until the present, and has left to another the task of proving its commercial value, he is deserving of none of the rewards.

Private vs. Municipal Control.

THE city of Austin, Texas, furnishes what may be termed a horrible example of municipal control of electric lighting. In 1890, the city decided to discontinue the arrangement under which the public lighting had been done by a private company at a cost of $18,000 per year, and adopted the project of constructing a gigantic dam across the Colorado river, three miles west of the city of Austin, by which it was expected that some 14,000 horse power could be developed and utilized for lighting and power purposes. The expectation was, that when this water power was made available, the city would become a great manufacturing centre, and the authorities had probably in view the idea of securing the lighting of the streets at little or no expense. The ratepayers, with these arguments before them, sanctioned the issue of bonds, bearing interest at five and six per cent. repayable in forty years, for the sum of $1,750,000, to cover the cost of construction of the works. The project has resulted in total failure both as regards the engineering work and the commercial results. Since its construction, serious leakages have taken place below and beneath the dam resulting in the lowering of the water to such an extent that very little power is now available. Apart from this is the serious fact that not a single manufactory has been brought to the city as the result of this power, so that the total expenditure has been practically thrown away, and the city finds itself placed under a burden of operating expenses and interest charges amounting to $174,000 per year, against which the revenue is only $60,000 per year. Added to this is the fact that sufficient power cannot be obtained, and the installation of an auxiliary steam power plant is now under consideration. The undertaking will probably bankrupt the municipality.

In connection with this subject of municipal control, we observe that the National Electric Light Association submitted a proposition to the League of American Municipalities at its recent convention in Syracuse, New York, to pay one-half the cost, not exceeding the sum of $5,000, to investigate and determine the cost of operation of five municipal lighting plants. The Municipal League accepted the proposition with the amendment added that the investigation should also include five private plants. It was pointed out that this amendment would prevent the carrying out of the proposition, as no one had authority to give the privilege of examining private plants, and owners of such plants could not be expected, under present circumstances, to disclose particulars of their business. The manager of a Canadian electric lighting company was asked by the National Electric Light Association to state what amount his company would be willing to contribute towards the cost of the proposed investigation. He laconically replied, "Not one cent," and proceeded to give the reason for his refusal, viz: That as a rule the promoters of municipal control of electric lighting do not look at the question from the standpoint of economy of the public funds, the aim being rather to obtain a larger control of public patronage to their own advantage and the advantage of their friends, and that therefore no figures which could be published showing from an economical standpoint the disadvantage of municipal control would have any effect in checking the agitation for munibipal control. A proper method of procedure is the one which was also made at the Syracuse convention, namely, that the legislatures should make it compulsory upon the management of all public utilities to present detailed annual statements in such form as would permit of comparison being made between the items of expenditure of the different plants whether operated by the municipality or by private companies. We are in accord with Mr. Francisco's statement at this convention, that the remedy is not municipal ownership but regulation. So far as Ontario is concerned, the Conmee Bill passed at the last session of the legislature is well calculated to protect the interests both of municipalities and lighting companies, so that the situation in this province is much improved as compared with the conditions which prevailed prior to the passing of this enactment.

MONTREAL

Branch Office of the Canadian Electrical News,
New York Life Building,
Montreal, October 30th, 1899.

ELECTRICAL DINNER.

The first annual dinner of the Y. M. C. A. Electrical Club was held on Friday, September 29th, in the Association building, at which there was a good attendance of members and their friends The menu was as follows:

MENU.

ELECTRIC JUICE.
Oyster Soup, Fresh Malpecque.
A la Submarine.
ROOSTER.
Chicken Pie.
A la Micro Farad.
JOINTS, Soldered and Taped.
Roast Beef.
Leather Belting.
Roast Turkey.
Carbon Trimmed.
SHUNTS.
Mashed Potatoes. Sweet Corn.
Grounded. Dismantled.
Lobster Salad.
A la Accumulator.
ISOLATED PLANT.
Celery.
DESSERT.
Insulating Compounds.
Charlotte Russe. Jelly.
Assorted Cakes. Multiple Series.

Ice Cream. Water Ice.
Self Cooler. A la Frazil.
FRUITS.
Pears, Apples, Grapes, Banannas.
INTERNAL RESISTANCE.
Cheese. Crackers.
TERMINALS.
Lemonade. Cafe Noir.
50,000 Volts. High Potential
Are You Finished? Ring Off. Transfer. "30."

The chair was occupied by the president. Mr. F. B. Horn, who explained that the object of the club was to visit electrical plants and to promote the social and educational welfare of the students of the electrical class in connection with the educational department of the Y. M. C. A. There were two main toasts, that of "Electricity" and "Our Association," which was responded to by Prof. Herdt, lecturer in electricity at McGill University, and honorary president of the club, and Mr. D. A. Budge, secretary of the Y.M.C.A. "The touch of electricity," said Prof. Herdt, "makes a great city. Take, for instance, the street railway power house, with its dynamos generating 10,000 horse power. Think of 10,000 horse power under one roof, saddled and ready for a start. Electricity has changed the manners and the customs of mankind."

Prof. L. A. Herdt, E.E., Ma.E.,
Honorary President Y. M. C. A. Electrical Club.

Mr. D. A. Budge, on behalf of the Association, gave an instance of the value to the members of the evening educational classes. He knew of a young man engaged in the G. T. R. shops who took up the study of mechanical drawing, acquiring knowledge that soon secured his advancement. At the time of the United States declaration of war with Spain, the Baldwin Locomotive Works, of Philadelphia, were under contract to equip a railway in the northern part of Spain, and had already shipped the locomotives. They did not wish, under the circumstances, to send a United States citizen to equip the road, and applied to the G. T. R. for a Britisher. The young man above referred to was sent and accomplished the work. On returning, he was sent to Cuba to report on the condition of locomotives wrecked in the Cuban war. Mr. Budge said that he became acquainted with these facts by a chance meeting with the young man on a recent holiday trip, the latter being then bound for South Africa to set up fifty locomotives for the Baldwin Company. He remarked to Mr. Budge that the improvement of his time in the evenings had had much to do with his promotion.

Mr. F. B. Horn,
President Y.M.C.A. Electrical Club.

The secretary of the club, Mr. J. F. C. Bray, gave a resume of the summer's work, which included lectures on "The Theory of the Telephone," by Fred B. Horn; "Interior Wiring," by T. F. Pickett; "The Electric Motor," by Prof. Herdt. Visits to the electrical plants were also made.

During the evening a programme was contributed by the following gentlemen: Mr. Crawford Grantham, piano solo; Mr. A. F. Cameron, song; Mr. R. H. Gibson, recitation; Mr. W. R. Wilson, song; Mr. Will Sutton, selections on the gramophone. The evening's enjoyment was brought to a close by the members joining hands and the hearty singing of "Auld Lang Syne."

Mr. J. F. C. Bray,
Secretary Y.M.C.A. Electrical Club.

INTERIOR WIRING.

Nearly every illuminating company in Canada, and in fact in the neighboring republic, have given up doing interior wiring. The Royal Electric Company, of Montreal, however, are unique in this respect, inasmuch as they still tender for such work. In a great measure success in this line depends on how the superintendent of that branch handles his customers. The Royal Company have a man who can do this to perfection, giving courteous treatment all round, looking to giving satisfaction in the work, and also after the interests of his employers. Such is Mr. J Douglas, in charge of the wiring department of that company. That he has had training in other branches of electric construction, from the common house bell to telephone and telegraph systems, no doubt forms a valuable auxiliary when looking after "trouble." He seems the right man in the right place, and would be hard to replace.

AN UNPROFITABLE PURCHASE.

A certain professional gentleman was prone to purchase in the United States some nice running motor, projecting arc light, etc., which might be useful to him in his business, only to find that the alternating current in use in Montreal was not healthy for the instruments when connected upon their arrival. Professional men are the first to complain if their patients do not take them into their confidence ; the local electrical fraternity may well say ditto. By a little consultation, the fee not being forthcoming as in the professional man's own case, he might have been saved a few almighty dollars.

"TRAMP ELECTRICIANS."

A nuisance has developed in Montreal, in the shape of miscreants who detach incandescent bulbs from corridor and hall brackets in public buildings and purloin them. As free renewals are given by both the Royal and Lachine companies, and as such lamps are not offered for sale so that the offender might be apprehended, it is to be inferred that these lamps are appropriated by "tramp" electricians who carry their office, etc., in their hat. They know the value of the goods, and can use them in their work. No wonder the legitimate business cannot tender against these gentry, and it is an injustice for any architect or citizen to employ such.

NEW BUILDINGS.

The new factory of Messrs. Tooke Bros , now being erected at St. Henri, near Montreal, will be well equipped electrically. The plant will consist of two new 54 k.w. generators, to be run on the three-wire system, supplying from an up-to-date switch-board of blue Vermont marble 900 incandescent lights, three 15 h.p. motors, two 8 h.p. motors, one 6 h.p. motor, and one 5 h.p. motor. There will also be a heating plant separate, consisting of their present factory generator and 60 enamel pattern sad irons. The new switch-board and generators will be supplied by the Canadian General Electric Company, as well as the 15 and 8 h.p. motors. The wiring and construction work is in the hands of the Montreal Electric Company.

The new Mount Royal Club building is probably the most exclusive as well as the most elaborate in Canada. It is the house built by the late Sir J. J. C. Abbott, used by Lord and Lady Aberdeen as their vice-regal residence in Montreal, and now entirely remodelled and extended by Messrs. Maxwell & Shattuck, architects, to suit the views of the gentlemen of the Mount Royal Club, who are some of the wealthiest in the Dominion. The wiring was done by Messrs. Lewis & Co., of Boston, and the fixtures specially designed by the architect and manufactured in the United States. They were hung and connected by the Montreal Electric Company.

The conduit for the new building of the Merchants' Bank of Canada in this city has just been installed, construction being by the Montreal Electric Company. The plant will be two wire, at 220 volts, and is thought to be the first of its kind here using 220 volt lamps. Although not at first contemplated, it is the intention to have their own private plant. The Royal Electric Company have been successful in securing the order for generators and switchboard. Sprague electric elevators will be used, supplied through the Montreal agents, Messrs. Jack & Robertson. The architects are Messrs. Maxwell & Shattuck.

MUNICIPAL REGULATIONS.

The proposed new building by-law for the city of Montreal contains the following regulations governing the installation of electrical apparatus :

All the electrical apparatus, wires, etc., for the generation or supply service in any central station or isolated plant, and all wires, lamps, motors, etc., used for light, power or heat in any public or private building, shall be installed according to and in conformity with the rules and regulations of the Canadian Association of Fire Underwriters, and in order to secure conformity to said rules and regulations, all such installations shall be subject to inspection and issuance of a certificate to that effect from the electrical inspection department of the city of Montreal. In order that proper inspection may be made, due notice shall be given the building inspection office of any intention to install any such electrical wires or apparatus for the purposes herein mentioned, in order to allow of inspection of the installation as the work progresses, and before any portion of the work is covered or concealed, and no installation shall be considered complete and in conformity with said rules and regulations until a certificate shall issue from the inspection department to that effect. In all cases, the inspection department shall have power to decide and determine whether such work has been done in a safe and proper manner, and the issuance of a certificate therefor shall be in evidence thereof.

All materials, switches, wire or any other auxiliary apparatus or device pertaining to said installations shall be subject to the inspection department before being used for such purpose.

All wires of any description, either for telegraph, telephone, electric light, heat or power, on, or entering any building, public or private, shall be subject to the supervision of the inspection department, and with power on the part of said department to compel the placing of those wires in a proper and safe manner.

All theatres and all public halls for scenic display shall be subject to inspection at least once a year.

In case of any installation, already in operation, either of generating plant, motors, wires, or other electric apparatus located in any building or premises, becoming defective to such an extent as to threaten immediate danger to life or property, the inspection department, having notice thereof, shall have immediate power to suspend the operation of such pending the necessary repairs.

The said inspector shall, at proper hours, have the right to enter any building or premises where electric power or light is being used, to inspect all electrical wires or apparatus, in order to ascertain if the proper regulations have been complied with, and no person shall refuse to allow such inspection.

No alterations or change shall be made in the plan of wiring any building without notifying the building inspector and securing a permit therefor, and subjecting the plan of wiring to inspection as herein provided.

NOTES.

The Electric Repair and Contracting Company have taken up new premises at 617 and 619 Lagauchetiere street, where they are doing a larger business, now having two stores.

The contract for the electric plant for Messrs. Henry Morgan & Co.'s building has been awarded, the generators going to the United Electric Co., Toronto, and the switchboard to the Canadian General Electric Company.

The Canadian Bryant Electric Company were slightly damaged by smoke and water recently by the fire in Messrs. Agnews' (dry goods) premises, over which their Montreal factory is located. They have decided to close down their Canadian branch.

For hustling around looking after his men, commend Mr. J. Bennett, foreman for the Montreal Electric Company's outside department. Covering mile after mile on his bicycle, and rushing things, is his usual occupation. There surely cannot be complaint of slow attention there.

Mr. John Forman, of Montreal, has recently been on an extended visit to New York and other American cities, ostensibly to witness the international yacht race. It is rumored, however, that he has not been becalmed, and that he brought home some new agencies. Mr. Forman intends moving at once into the more commodious premises which he has lately leased and which are located about a block west of his present stand on Craig street.

The Canadian General Electric Company are to be congratulated in their chief at Montreal. Mr. Dean is universally esteemed by the trade in general. The thorough knowledge he has of his subject, and the quiet, gentlemanly way he has of impressing that fact on his customer, might serve as a "pointer" for others in electrical lines. Mr. Dean's first lieutenant, Mr. J. W. Pilcher, who has lately been promoted to the Halifax agency, has been replaced by Mr. Bell, who bids fair to become popular.

Strange when giants fight, how the small one makes a quiet, comfortable living right in amongst the fighters. Mr. Chas. Morton, manager of the Standard Electric Co. (formerly the Temple Electric Co.), of Montreal, with station located on Chenneville street, has reason to be proud of his management. As possibly the profit division may not be public, your correspondent wil reserve the actual figures, merely stating that it is more satisfactory than certain others in Montreal. This may partly be due to Mr. Morton's desire to avoid legal proceedings with a customer whenever possible, and to try and give satisfaction all round. That he manages to do so is evidenced by his keeping old customers with him. The current furnished from this station is principally 250 volt direct current for motors, the lighting current now being obtained from the Lachine Company and is, of course, alternating.

CORRESPONDENCE.

SEARCH LIGHTS ON VESSELS.

MONTREAL, October 27th, 1899.

Editor CANADIAN ELECTRICAL NEWS:

SOME time ago the idea was broached by some person in Montreal to use search lights on vessels, by means of which it was intended that pilots could pick out the river buoys and guide steamships, etc., down the channel by night as well as by day. Referring to a back number of the CANADIAN ELECTRICAL NEWS, where the item appeared, I notice that storage batteries were also suggested for such vessels as did not possess their own dynamos.

The writer purposely refrained from referring to this matter before, thinking that possibly he might damage the promotion of some scheme, but seeing that the close of navigation is now upon us, and that no one has adopted the brilliant (?) idea, a few words on local conditions may not be amiss to show just what an undertaking this seemingly simple scheme means.

First, let us take vessels equipped with dynamos: The writer knows that some have alternating machines on board, which, although in itself no obstacle, would prevent any search-light which the harbor commissioners might keep on hand (or even the steamship line) as common property being utilized, as, of course, most of the equipments are direct current. The question would then be, shall two different types at least of search lights be kept on hand? Again, no matter what current was used, has any vessel got from 20 to 40 amperes to spare, which would be required for a search light to be at all useful? From a considerable experience the writer emphatically says "NO."

Without going further along this line, let us proceed to the storage battery suggestion. This the writer regards as worse than the first proposition, for at least 200 ampere hours capacity would be required, at say 45 volts, using no less than 43 heavy cells!! Now, the decks are pretty well hampered until Quebec is reached without adding this additional litter (even were it possible). To "charge" these cells we have available (unless a special plant were installed on shore for the purpose) an alternating service or direct current arc circuit, the latter being only in use from dusk until day-break, and furnishing 10 amperes!

Enough has been said to show the futility of the scheme, although why ship owners do not provide their original installation on each vessel with a permanent search light is hard to say, seeing that such a piece of apparatus would be a valuable adjunct in many ways.

Yours truly,

"HARBOR."

N.B.—What is the matter with Pintsch gas buoys?

REMINISCENCES OF THE OLD MONTREAL ELECTRIC CLUB.

MONTERAL, Oct. 19, 1899.

Editor ELECTRICAL NEWS:

Looking over some old fyles of the NEWS, it struck the writer, who was connected with the club, and who like many others that were in it still takes the NEWS, that a few words on the subject might be interesting, not only to those whose idea is to form a similar club, as is mooted for the forthcoming winter, but possibly to some of the old members themselves.

First, let it be known that the club met every cent of its financial obligations to the last, and both finances and club terminated with its last meeting. That this was so was due to the untiring work of the then secretary-treasurer, Mr. Doutre, as latterly there was a most discouraging turn-out to the meetings in point of numbers. The question will be asked as to why such a flourishing club originally slowly died out? The reason was simply "lack of new blood," i. e., of effective new blood, of members willing to take their share in submitting papers or in pertinent discussion of those which were submitted.

One of the first to leave "per force" was the first vice-president that the club had, Mr. H. Woodman, who left to assume the position of electrician for the town of Joliette, Que., and who later bettered himself as electrician for the North Shore Company's transmission plant at Three Rivers, Que. As he took an exceedingly active interest in the club's affairs, his loss was keenly felt. The next member (another of those interested members) to leave was Mr. L. Burran, who left the Royal Company at Montreal to assume the duties of electrician to the Montmorency Electric Power Company's plant at Quebec. Then followed Mr. H. Brown, who went to St. John, N. B., to manage the electric light plant at that city. Mr. L. Pignolet, who now conducts his own business in electrical specialities on Cortlandt st., New York, and many others, could be mentioned.

A few of the old boys are still quartered in Montreal, such as: Mr. J. Douglas, now superintendent of the wiring department of the Royal Electric Company, Mr. W. Shaw (former president of the club), together with his brother, Mr. J. Shaw, who now constitute the Montreal Electric Company; Mr. J. Burnett, first secretary of the club; Mr. T. Murphy, of F. Thomson & Co., now well known for his inventive genius; Mr. G. Hill and Mr. C. Doutre, both with John Forman, Montreal, and others.

The hardest work naturally fell on the secretary, which like all offices, was a purely honorary position, and it is doubtful whether Mr. Burnett the first, or Mr. C. Doutre the last holding the office, bore off the palm in that sense; certainly both were a credit to their club.

By the foregoing remarks it is clearly shown that the club was not an electric light monopoly, as there was as much interest displayed in Mr. W. Graham's (of G. N. W. Tel. Co.) paper on telegraphy as on Mr. Ritchie's (of Can. Gen. Elec. Co.) paper on alternate current machinery. Mr. Ritchie, by the way, replaced Mr. Pignolet as vice-president, only in turn to leave for Toronto himself soon after.

The club may or may not have helped some; certainly, however, it does not appear to have done any harm, as every name mentioned is holding a higher position than when members of the old club.

The papers in the main were excellent, and the only thing necessary to keep a new club going is a little more active interest. It will go, is in fact bound to go, if every member will make it a point to discuss something in papers submitted, and do their share either collectively or individually in preparing papers so that this will not be the lot of a special few. With best wishes for a resurrection,

I am yours respectfully,

"CLUB."

ELECTRIC LIGHT VS. ACETYLENE GAS.

TORONTO, October 25th, 1899.

Editor ELECTRICAL NEWS:

DEAR SIR,—I notice that the Canadian Manufacturer takes exception to the statistics compiled by the Canadian Electrical Association (not by the CANADIAN ELECTRICAL NEWS) re acetylene; and why? Has acetylene an association composed of men of integrity all over Canada who have compiled a contrary report? I think not.

Do the construction firms who are busy installing wiring for incandescent light find the demand for acetylene such as is interfering with their business? Ask them!!

Are the insurance regulations governing the installation (properly) of acetylene plants more stringent than those governing the installation (properly) of electric plants? Read them, and even a lay-man will say that they appear so.

Acetylene has its place; but that it will drive out the incandescent light from dwellings, stores, theatres, or churches yet remains to be seen. There are several companies manufacturing acetylene generators and similar fittings (I do not refer to those manufacturing carbide); have any of these paid any dividend?

Yours truly,

ONE WHO HAS STUDIED BOTH.

QUESTIONS AND ANSWERS.

A Montreal subscriber writes: Would it be possible to light a dwelling and barns in a country like Manitoba by using electric light, the motive power being a wind mill? Has it ever been tried? Would require about 25 lights. What would be the cost of a dynamo and shafting for such a plant, and for a storage battery if one was required?

Answer: It would be possible but not profitable to operate a plant in the manner suggested. If the plant was large enough and an expert electrician was put in charge of it, it might be done, but even then the cost of the light would be altogether out of proportion to its value. Unless a man is willing to put a few thousand dollars into a hobby and devote leisure to looking after it, we would not advise him to have anything to do with an experiment of this kind.

THE LATE T. G. HAZLITT.

On October 12th there passed away a prominent business man and respected citizen of the town of Peterborough, Ont., in the person of Mr. T. G. Hazlitt, president of the Peterborough Light & Power Company Mr. Hazlitt was born in the county of Armagh, Ireland, in the year 1823, and came to Canada when twenty-four years of age. He was for some years a teacher in the Picton Grammar School, and in the year 1852 removed to Peterborough and embarked in mercantile pursuits. In 1865 he became associated in the lumber business with the late Samuel Dickson, and upon the demise of the latter gentleman in 1870, the management of the estate was placed in Mr. Hazlitt's hands. In this connection he exhibited much ability, steadily building up a profitable business. In 1885 The Dickson Company of Peterborough, Limited, was organized for the purpose of carrying on the business of the estate, and Mr. Hazlitt was appointed managing director and president.

The Late T. G. Hazlitt.

Mr. Hazlitt was the pioneer of electric lighting in the town of Peterborough. Upon the formation of the Peterborough Light & Power Company, nine years ago, he became its president, a position which he has occupied ever since.

BURLEIGH FALLS-PETERBORO-LINDSAY TRANSMISSION.

Mr. J. Alex. Culverwell, of Toronto, one of the owners of Burleigh Falls, and promoter of the Burleigh Falls-Peterborough-Lindsay electric power enterprise, states that he has succeeded in making financial arrangements with a prominent New York banking house for the completion of this undertaking. The company will be designated as the Central Ontario Power Company.

The Canadian directors have been announced in the local press as :—Hon. Richard Harcourt, Minister of Education for Ontario ; James Hendry, M.P., Peterborough, president Auburn Power Co.; F. W. Barrett, Toronto, manufacturer ; R. J. McLaughlin, Lindsay, barrister and director Victoria Loan & Savings Co.; Dr. Edward Adams, Toronto, and J. Alex. Culverwell, promoter, Toronto, late local manager for Toronto and Central Ontario of Royal Victoria Life Insurance Co., and formerly with Edison General Electric Co.

Burleigh Falls is situated seventeen miles from Peterborough and 39 miles from Lindsay on the same circuit. Plans of dam and power house, to be located in Perry's Gorge, have just been completed, which are said to prove that the hydraulic development will cost less than any proportionate power development on the continent. The head of water is twenty-seven feet, and the minimum flow of water in the dryest season by official reports show three thousand horse power, while the magnificent reservoir capacity adjacent to the falls (and which can be used) will give 4,500 horse power during the hours of heavy load.

The original syndicate organized early last summer purchased all the private interests at the falls, and Mr. Culverwell conducted and completed the negotiations with both governments for the acquirement of the balance of the interests.

Contracted revenue for lighting and power in the several towns was secured during the past summer to the amount of $50,000 per year of five and ten years' duration, including the street lighting of the town of Lindsay for ten years, and all the necessary franchises for the different municipalities have been secured. This revenue will be increased materially at once. It is understood that work will be commenced this fall—the hydraulic development being not a great undertaking, the main dam being built and maintained by the governments as part of the Trent Canal system, while a natural flume (Perry's Gorge) already exists, which together probably makes a saving of an expenditure of some $100,000, which would otherwise be necessary. Three 700 horse power generators and other requisite apparatus will be installed at the beginning, and allowance made in the power house for further increase.

PERSONAL.

Mr. David A. Williamson has been appointed Fellow in Electrical Engineering at the School of Practical Science, Toronto.

The resignation is announced of Mr. Geo. F. Evans, manager for Canada of the Westinghouse Manufacturing Co., Limited.

Mr. Birchard, who has been employed at the electric light works at Amherstburg, Ont., has accepted a position in the shops of the Toronto Railway Company.

Mr. W. W. Brown, who has had charge of the lighting plant at Petrolia, Ont., since its establishment, has gone to Camp McKinney, B.C., to take charge of the plant of the Minnehaha Mining Company.

Mr. John P. Northey, president of the Northey Manufacturing Company, Toronto, was married on October 24th to Miss Adelaide Wadsworth. The ceremony took place in St. Thomas church, Toronto. We extend congratulations.

The Electrical News extends its congratulations to Mr. Edward Slade, the well known electrical engineer and contractor, of Quebec, upon his appointment to the position of general manager of the Jacques Cartier Electric Light & Power Co. Besides being a thorough electrician, Mr. Slade possesses sufficient energy and progressiveness to make a success of that which he undertakes, and under his management we predict prosperity for the company. It is expected that the company will shortly be in a position to supply light and power. The poles on the streets are now being erected, and plans are in course of preparation for a handsome building to be built on the corner of St. John and d'Autueil streets to be used as the head office. In the meantime, temporary quarters have been secured.

Incandescent lamp makers will be interested in the statement that a Frenchman, L. C. Dumas, has discovered that an alloy of nickel and steel has practically the same coefficient of expansion as glass, and may be used as a substitute for platinum in the leading-in wires of lamps. The proportion of the metals is said to be : Nickel, 45 per cent.; steel, 55 per cent. The exact composition of the steel is not stated. If this statement proves to be true, it will be of considerable importance to manufacturers of lamps.

TELEGRAPH and TELEPHONE

WIRELESS TELEPHONY.

The Carnarvon and Denbigh Herald states that for some weeks past experiments of great interest in wireless telephony, as distinguished from Signor Marconi's wireless telegraphy, have been carried on near Carnarvon by Sir Henry William Preece. Four high poles have been erected near Llanfaglan church at the south end of Menai Straits. On a sandbank across Gwyrfal river, half a mile off, four similar poles are erected. Half a mile still further, at Belan Fort, is a high pole supporting a coil of wire, one end being anchored in the deep water. Between these points Sir William has succeeded, without any intermediary other than the ether, in transmitting the sound of a succession of taps. These taps were made with a view of sending messages by the Morse code. They were distinctly heard at the receiving station by placing the newly-invented ethereal telephone to the ear, messages being sent without interruption for several days. Further experiments from Belan Fort to Llanddwyn lighthouse and to Carnarvon castle are contemplated. So far the system yields much more rapid results than Marconi's, although the sounds are not quite distinct.

CONSOLIDATION OF TELEGRAPH COMPANIES.

In answering the question of a correspondent, the Monetary Times gives the following concise particulars of the consolidation of the telegraph companies :

"In 1881 the Great Northwestern Telegraph Company of Canada leased the wires and other property of the Montreal Telegraph Company, extending over all the Eastern provinces of Canada, and over part of Manitoba and several of the northern States. It also leased the wires of the Dominion Telegraph Company in Canada. These two sets of lines were merged into one for purposes of economy. The terms of lease were that eight per cent. upon the $2,000,000 capital of the Montreal Company, and six per cent. upon that of the Dominion Company, should be paid annually. For this bargain the Western Union Telegraph Company of the United States became guarantor. For several years the G.N.W. Company was able to pay this enormous rental, even with the low rate of tolls (25 cents for ten words). But when the C.P.R. Telegraph came into existence, and the Bell Telephone Co. built lines connecting towns, the business was so divided that the G.N.W. Telegraph Co.'s revenue fell off. It has not paid dividends to its shareholders for years. But the payments to the lessors have gone on regularly every year, and the shareholders of the Montreal Telegraph Company and of the Dominion Telegraph Company get their dividends regularly of eight per cent. and six per cent respectively. The extent of wires handled by the G.N.W. Company is 40,000 miles, and by the C.P.R. about 25,000 miles."

Wm. Kennedy & Sons, Limited, of Owen Sound, Ont., have purchased a 500 light electric plant from the Canadian General Electric Company, consisting of one of the latter company's latest type H multipolar generator, with marble panel switchboard and wiring material for their work throughout.

SHORT CIRCUITS.

The North American Telegraph Company is installing a new telephone exchange for the town of Tweed, Ont.

The Yarmouth Telephone Company is building a line between Belleville and Springhaven, N.S., a distance of eight miles.

The C.P.R. is constructing a telegraph line from Harriston to Listowel, Ont. Mr. C. Hacking will be manager at the latter place.

The directors of the British Columbia Telephones, Limited, have issued their first annual report to June 30th. The statement shows a profit of £4,111.

The Bell Telephone Company has decided to construct a long distance line between Winnipeg, Portage la Prairie and Neepawa, Man. The line will be a copper metallic one.

For the supply of 165 tons of wire for the proposed telegraph line from Quesnelle, B.C., to Atlin, the contract has been awarded by the Dominion government to Mr. J. A. Seybold, of Ottawa.

Mr. W. F. Snyder, of Sydney, C.B., for some years telegraph and cable manager for the Western Union Telegraph Company in Cape Breton, and one of the best known telegraphers in the maritime province, died on October 9th, after a long illness. He was a native of Philadelphia and was fifty-seven years of age.

The telephone systems of Victoria, Vancouver and New Westminster are reported to have been acquired by a syndicate of eastern capitalits, who, besides improving the system, will establish a long distance telephone service between Victoria and the mainland. Mr. A. C. Flumerfelt, of Victoria, represented the purchasers.

Mr. J. R. MacMurty, representing the owners of the Dodge system of telephony, has made application to several municipal councils in Canada for permission to erect poles on the streets and for other privileges necessary to a telephone system. Many of the municipalities have given an exclusive franchise to the Bell Telephone Company, and are not in a position to consider the proposition.

The Merchants Telephone Company, of Montreal, held its annual meeting a fortnight ago, Mr. A. S. Hamelin presiding. It was reported that the business of the company was increasing, and that it was the intention to connect their system with as many outside lines as possible. The election of officers resulted as follows : President, A. S. Hamelin ; vice-president, J. E. Beaudoin ; secretary, J. M. Marcotte ; treasurer, L. E. Beauchamp.

The announcement was made during the past month that Mr. Chas. R. Hosmer, manager of the Canadian Pacific telegraph system since its inauguration, is about to retire from that position. For some time past he has been gradually relieving himself of the details of the telegraph business, and before the close of the present year expects to be entirely relieved of his official duties. Mr. Hosmer's management of the telegraph branch of the C.P.R. has been such as to stamp him a man of great resource and enterprise. Rising from the "key," he knew well the details of his department, and this intimate knowledge was responsible in no small degree for his remarkable success. He has just been appointed to the directorate of the C.P.R.

The Dominion government Telegraph Department announces the completion of the telegraph line from Skagway, Alaska, to Dawson City. The line is over 600 miles in length, and with the exception of forty-one miles from Skagway to Lake Bennett, constructed by the White Pass Railway Company, was built entirely by the Dominion Government. The schedule of rates to be charged as given below shows that a ten word message to Dawson City costs $4.35 :

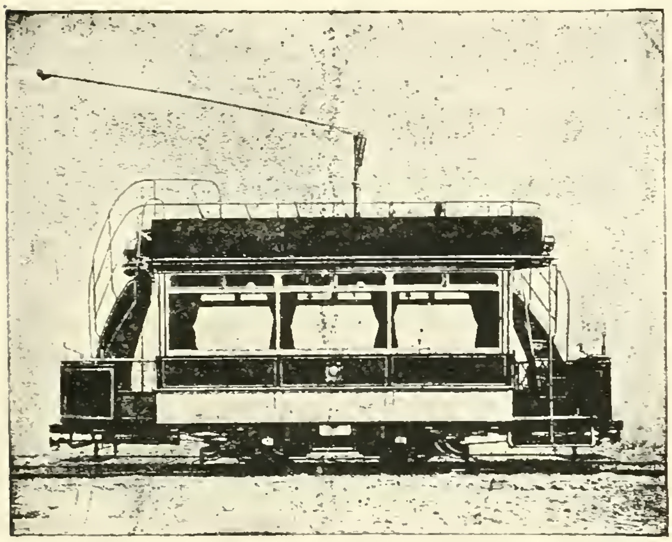
	Ten Words.	Each. Additional Word.
Skagway, Alaska	$0 35	
Bennett, N.W.T.	1 35	5 cents.
Cariboo Crossing, N.W.T.	1 85	10 cents.
Tagish, N.W.T.	1 95	10 cents.
Miles Canyon, N.W.T.	2 10	10 cents.
White Horse, N.W.T.	2 10	10 cents.
Lower Labarge, N.W.T.	2 35	15 cents.
Hootelinqua, N.W.T.	2 60	15 cents.
Five Finger, N.W.T.	3 35	20 cents.
Fort Selkirk, N.W.T.	3 85	20 cents.
Dawson City, N.W.T.	4 35	20 cents.

A resolution has been passed by the town council of Pembroke, Ont., authorizing the Fire and Light Committee to negotiate with the Pembroke Electric Light Company for the purchase of its plant.

ELECTRIC RAILWAY DEPARTMENT.

ENGLISH TRAMCARS.

From the Electrical Engineer, of London, England, we learn that the Liverpool corporation have accepted the tender of Messrs. Dick, Kerr & Co., Limited, for 200 complete electric tramcars. This brings up the whole number of motors and cars ordered by the Liverpool corporation from this firm to 304 cars, with 620 motors. The whole of the cars and motor equipment will be manufactured in England. All the work will be done at Preston, the car bodies being made at the workshops of the Electric Railway and Tramway Carriage Works, Limited, while the motors and controllers will be manufactured by the Electrical Equipment Syndicate. The workshops of this syndicate are to be completed by December 31. These new works at Preston are designed and equipped to turn out 3,000 tramway motors and dynamos up to 50,000 h.p. in the aggregate in the course of a year. Although these figures may seem large, if looked at by the side of the above-mentioned order, the wisdom of fixing the possible output high is readily seen. Thus five such orders as the company has now in hand for Liverpool would take the output of the works for one year. As regards the delivery of these cars, the guarantee is that 50 cars should be supplied quarterly. The illustration we give herewith showing the general design of these Liverpool tramcars will be interesting to Canadians.



An English Tramcar.

THE MONTREAL STREET RAILWAY COMPANY.

The annual meeting of the Montreal Street Railway Company was held on Thursday, November 2nd. The annual report submitted by the directors showed a net profit of $630,870.61 for the year, as compared with $601,704.18 for the previous year. Out of this amount there were declared four dividends of two and one-half per cent. each, amounting in all to $478,333.33, leaving a surplus of $152,537.28, of which amount the sum of $50,000 was added to the contingency account, and there was charged against that fund an amount of $8,575 expended during the year for fenders and other special renewals. The percentage of operating expenses showed an increase of 3.08 per cent. as compared with last year. New car shops and other buildings were erected at Hochelaga. The rolling stock was increased during the year by 64 closed motor cars, 100 open motor cars, one pay car, and 12 electric sweepers, and there are under construction 36 closed motor cars of increased seating capacity. The Sleeman type of fender was adopted. The result of the cast welded rail joints introduced last year was satisfactory.

There were carried during the year 40,186,493 passengers, against 35,353,036 in 1898, 32,047,317 in 1897, 29,896,471 in 1896, and 25,877,758 in 1895. There were granted 12,060,867 transfers last year and 10,508,603 in 1898. The gross receipts last year were $1,660,775.93, against $1,471,939.65 in 1898. The operating expenses for the two years were $912,949.66 and $764,883.35 respectively. The annual report was accompanied by a statistical statement showing the enormous growth of street railway traffic in Montreal during the past seven years.

THE BELT LINE TROLLEY SYSTEM AT NIAGARA.

The new bridge across the Niagara river between Lewiston, N.Y., and Queenston, Ont., completes the belt line trolley system which extends about eight miles up and down the river above and below the Falls and encloses all the Gorge. The bridge carries a single track electric car line with a roadway on each side. The main span consists of a 25 foot half-deck roadway platform carried by a pair of riveted Warren stiffening trusses suspended from four main cables 1,040 feet long between centres of towers. The end of the trusses are pivoted to rocker bents which are continued about them in the same vertical tranverse planes to their intersections with the main cable, to which they are pin connected. From the ends of their stiffening trusses the roadway is carried to solid ground by skew pans 34½ feet long on the New York side and 19½ feet long on the Canadian side. The New York span consists of plate girders and the Canadian span of I beams. The cables are designed to support two trolley cars weighing 86,000 pounds on a wheel base of 60 feet plus a uniform load of 1000 pounds per lineal foot over the whole span. The trusses are made of medium open-hearth steel and are proportioned for the same load, except that one-third of the span is assumed free from the uniform loading. The floor system is designed to carry the same trolley car load on eight axles, plus a concentrated load of 8,000 pounds at any point on each side of the roadway.

There is some talk of an electric railway being built between Bracebridge and Muskoka Lake.

A movement is on foot looking to the construction of an electric railway from Bear River to Digby, N.S.

The St. Hyacinthe Electric Railway Company is seeking incorporation from the Quebec government, to build an electric railway from St. Hyacinthe, Que., to adjacent points.

Messrs. Ickes & Armstrong have accepted the franchise for a street railway offered by the town of Woodstock, Ont., and it is understood that they will shortly commence the work of construction.

ENGINEERING and MECHANICS

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

ANNUAL DINNER OF TORONTO NO. 1.

Following the custom of past years, the annual re-union and banquet of Toronto No. 1 was held on Thanksgiving Eve, October 18th. It was the thirteenth annual dinner of the association, and took place at Webb's parlors. The event was a complete success from every standpoint. The attendance was large, probably 150 persons, the accommodation of the best, and the arrangements for entertainment most complete and carefully carried out. Mr. H. E. Terry, president of Toronto No. 1, wielded the gavel, discharging his duties in such a manner as to earn the distinction of a most efficient presiding officer. Around the head table sat Mayor Shaw; Ald. Hallam; Ald. Frame; R. C. Pettigrew, Hamilton, executive president; G. C. Mooring, executive vice-president; A. M. Wickens, executive secretary; Chas. Moseley, executive treasurer; E. J. Philip, past-president; A. McRae, chief engineer Toronto waterworks; and A. E. Edkins, of the Boiler Inspection & Insurance Company. Among the other visitors were noticed A. E. Lewis and F. N. Vanzant, of the Atlantic Refining Company, Toronto; J. J. Bain, traveller Atlantic Refining Company; G. B. Towers, Vacuum Oil Company, Toronto; Wm. Sutton, Wm. Sutton Compound Company; Mr. Sinclair, Eureka Mineral Wool Company.

MR. H. E. TERRY, President Toronto No. 1.

An excellent menu was served in Webb's usual good style and heartily partaken of. The chairman, in a few well chosen words, welcomed the engineers and their friends to the thirteenth annual banquet. He spoke of the success of Toronto No. 1, and pointed out that it augured well for the association that at the present time only two members were out of employment. The past year had been most successful, and he looked for greater things in the future. He then called upon Mr. John Alexander for a song, which was rendered most acceptably.

Proceeding to the toast list, "The Queen" was honored by the singing of the National Anthem, followed by "Canada, Our Home," with which the president coupled the name of Ald Hallam. In responding, Ald. Hallam spoke of the great extent of Canada, pointing out that it was 275,000 square miles larger than the United States and only 300,000 square miles less than the whole area of Europe. Touching on municipal affairs, he announced his intention of being a candidate for the mayoralty of Toronto, a city which he had served for twenty-eight years. A duet was then rendered by Messrs. G. W. Grant and John Alexander, who gave as an encore "Boys of the Old Brigade."

With the toast of "Toronto, Our City," were coupled the names of Mayor Shaw and Ald. Frame. Mayor Shaw was sure the engineers were sharing in the general prosperity which prevades the whole Dominion and especially the city of Toronto. The city council this year, he thought, could claim a fair measure of success, inasmuch as the encouragement given to manufacturers had resulted in the building of new factories and large additions to existing establishments. The engineers would certainly benefit by these new industries. Referring to the delay in completing the city hall, he said that it had not been an unmitigated evil, as it had given employment to workmen during the times of depression. The building was certainly a creditable one, and he thought that large buildings inspired great and noble thoughts. Upon resuming his seat he was heartily applauded. Ald. Frame complimented the chairman upon his position and for his ability as a presiding officer. The engineers, he said, were an intelligent class of men, and were entrusted with the safety of many lives. Mr. Will Prestwich then favored the guests with a humorous song, which called forth a hearty encore.

Mr. George Baker and Mr. John Main responded to the toast of "The Manufacturers." Mr. Baker said that the next few years gave every indication of being a period of prosperity. He had noticed that high prices for iron and good times came hand in hand. Pig iron which six months ago could be purchased for $12 per ton was now selling at $24, and there was almost a famine in steel. He was pleased to learn that the engineers were banded together for educational purposes. Here Mr. Powers sang, after which Mr. Main, the friend of engineers, was called upon. Mr. Main said that he had been present at ten of the thirteen banquets held by Toronto No. 1. Speaking from the standpoint of a boiler manufacturer, he reported business exceptionally good, and did not know of one boiler maker who was out of employment. Work from Halifax to Vancouver was coming into Toronto, but notwithstanding this he found competition as keen as ever, but thought that in the near future prices would advance. He noticed many engineers present who were at the dinner thirteen years ago in the old Montreal house on King street. To-day the engineers had better opportunities for improvement than they had at that time. Mr. Main obtained his technical education in the old Mechanics Institute at the corner of King and Church street. In his opinion, technical education fitted a person for engineering and mechanical work as nothing else can do. He advised the older men to seek to obtain this education, otherwise they would be replaced by the younger men. Mr. Main said that the enrollment of the Technical School this year was 800 and the average attendance 300, but at the present time the school was in an unsettled state owing to the necessity of new quarters. He expressed surprise that the city representatives had said nothing about a permanent building for the school. Ald. Hallam asked for the privilege to say a few words in reply to Mr. Main. The position regarding the Technical School, he said, was that the council had voted $75,000 which had been legalized by parliament, and another $25,000 was yet required. The council had appointed a committee to make a report on the question, but as yet this report had not been forthcoming. As soon as this $25,000 was voted the building would be erected. He was a firm believer in the technical school. He knew a young man who had obtained his rudimentary education in the Technical School in this city who was now in New York receiving a salary of $4,000 per year as electrical engineer.

The chairman then read a telegram from Chicago from Mr. C. H. Rust, city engineer of Toronto, regretting his inability to be present and wishing the engineers success. A trombone solo by Mr. Grey was much appreciated, after which came the toast of "The Executive," to which Messrs. Pettigrew, Mooring and Moseley were the respondents. Upon rising to speak, Mr. Pettigrew, the president of the executive, was loudly cheered. He characterized the Canadian Association of Stationary Engineers as the greatest institution in existence. The executive was prospering and was reaching out both east and west. From an educational point of view they hoped to put still more energy into the association. The secretary was sending out question papers to the different associations with a view to helping the engineers in rural places who had not as good facilities for education as are enjoyed by the members of the larger places. Mr. Alexander was called upon for another song. Mr. Monring, vice-president, spoke particularly of compulsory legislation. This year a committee had been appointed to endeavor to obtain a law from the Ontario legislature, and he hoped every engineer would do what he could to assist the movement. The steamboa men now had such a aw, and it was quite as necessary that stationary engineers should give proof of their ability to take charge of steam plants. The treasurer, Mr. Moseley, was pleased to state that the finances of the executive were in good condition. He also spoke of legislation, stating that the Ontario permissive law, granted in 1891, had not had the desired effect in establishing the engineering business. A compulsory law would result in placing steam plants in charge of competent men Another humorous song by Mr. Prestwich followed.

Next came the toast "Sister Associations." Mr. Robert Mackie, in responding, made some humorous comparisons between the cities of Hamilton and Toronto, and expreseed his regret that the mayor had not remained until he (Mr. Mackie) could give him a few pointers. He said that the Hamilton association had commenced their winter educational work, holding two meetings each month, one being private and the other open to the public. Mr. Alex. McRae, a member of the Marine Engineers' Association, also replied, giving it as his opinion that a stationary engineers' law was as much required as was one for marine engineers. He instanced the case of a boiler that was taken out of a tug, condemned, and laid away as useless. This boiler found its way to a second hand dealer, who sold it to a saw mill man for his mill.

A song by Mr. Grant was encored.

A toast not found on the list was then proposed by Mr. Pettigrew and heartily drunk, it being that of "Toronto No. 1." With it were coupled the names of Messrs. H. E. Terry, A. M. Wickens and James Huggett. Mr. Terry said that as the banner association Toronto No. 1 was endeavoring to do its part. He appreciated the honor which had been conferred upon him by his election as president, and was pleased that there was such a large gathering of engineers and friends at their dinner. Mr. Wickens, in replying, said that he had been connected with the Stationary Engineers' Association since its inception. In no line of business did there exist greater necessity of advancing than in steam engineering, excepting, perhaps, in the electrical business. But the best mechanical engineers were gaining experience every day from the stationary engineers, therefore a man should take every opportunity to improve himself. In Toronto there were about 600 engineers, 220 of whom were members of the association. Any organization with education for its platform was, he thought, bound to succeed. Speaking of legislation, he contended that boiler explosions were not accidents, but were the result of carelessness, ignorance or parsimony. If the engineers were granted a compulsory law, it would be better for employers, as it would save them fuel. Mr. Huggett referred to the representation on the Technical School Board. In his opinion the stationary engineers, who were really the founders of the school, should still be represented. The association was in no way identified with the Trades and Labor Council, as some supposed.

The concluding toast was that of "The Press," responded to by Mr. E. B. Biggar, of the Canadian Engineer, and T. S. Young, of the ELECTRICAL NEWS AND ENGINEERING JOURNAL. The singing of "God Save the Queen" concluded the programme of the evening.

The untiring efforts of the members of the Dinner Committee was responsible in no small degree for the success of the dinner. This committee consisted of A. M. Wickens, chairman; Geo. Thompson, secretary-treasurer; G. C. Mooring, James Huggett, Alex. Storer, A. E. Edkins, Chas. Moseley and James Bannan. The pianist on the occasion was Mr. Harrison.

MATHEMATICS FOR ENGINEERS.*

By T. R. FESSENDEN.

[No. 1.]

IF you divide any one thing into a number of equal parts and take one or more of these parts, you have what is called a fraction. Thus, if we divide a line into seven equal parts and take three of them, we have the fraction three-sevenths, written thus, $\frac{3}{7}$, the number below the line showing into how many equal parts the line is divided, and called the denominator, and the number above the line telling how many equal parts are taken, and called the numerator.

A proper fraction is one whose numerator is less than its denominator, as $\frac{9}{10}$, $\frac{12}{20}$. An improper fraction is a whole number and a fraction, called a mixed number, reduced to the form of a fraction; thus $8\frac{1}{2}$, a mixed number, equals the improper fraction $\frac{17}{2}$.

If we multiply or divide both terms of a fraction by the same number the value of the fraction is not changed; thus, 2 and 3 are the terms of $\frac{2}{3}$; now, if we multiply both by 5 we have 10 and 15, or $\frac{10}{15}$, which is equal to $\frac{2}{3}$, for if we have a unit divided into three equal parts, and again divide each of these thirds into five equal parts, or 15 in $\frac{3}{3}$, we have 2 × 5 of the 15th, or $\frac{10}{15}$. Also, if we divide 10 and 15 by 5 we obtain 2 and 3, or $\frac{2}{3}$. Take the fraction $\frac{16}{24}$, if we divide 16 and 24 by 4, we obtain 4 and 6, or $\frac{4}{6}$, and, dividing both terms by 2, get $\frac{2}{3}$. Thus, if we have two or more fractions of different denominators and wish to add their values together, we can obtain by multiplication equivalent fractions having the same denomination, or a common denominator, thus, $\frac{2}{3}+\frac{4}{5}$; the denominators are 3 and 5, and a common denominator is 15;

$$15 \div 3 = 5,\ 15 \div 5 = 3,\quad \frac{5 \times 2}{5 \times 3} = \frac{10}{15},\quad \frac{3 \times 4}{3 \times 5} = \frac{12}{15},\ \text{thus}\ \frac{2}{3}+\frac{4}{5}=\frac{10}{15}+\frac{12}{15}=\frac{22}{15}.$$

Again, $\frac{3}{4}+\frac{1}{7}+\frac{3}{8}$. The denominators are 4, 7 and 8, and a common denominator would be $4 \times 7 \times 8 = 224$, but for ease in working we use the smallest common denominator, or 56, which is the least common multiple of the denominator. Now $56 \div 4 = 14$, $56 \div 7 = 8$, $56 \div 8 = 7$;

$$\frac{14 \times 3}{14 \times 4} = \frac{42}{56},\quad \frac{8 \times 1}{8 \times 7} = \frac{8}{56},\quad \frac{7 \times 3}{7 \times 8} = \frac{21}{56},\ \text{or}\ \frac{3}{4}+\frac{1}{7}+\frac{3}{8}=\frac{42}{56}+\frac{8}{56}+\frac{21}{56}=\frac{71}{56}.$$

The common way is thus:

$$\frac{3}{4}+\frac{1}{7}+\frac{3}{8},\quad \frac{42+8+21}{56}=\frac{71}{56}.$$

Draw a line below the fraction and place the common denominator below it. Under each fraction place its equivalent value in the common denominator, add the numerators thus obtained to form the new numerator, and place the common denominator as the new denominator. If we have mixed numbers, add the fractions, and if answer is an improper fraction, reduce to a whole and mixed number and then add the whole numbers.

In subtraction of fractions we must again reduce to fraction having a common denominator and then subtract. If we have to subtract mixed numbers, the figures are placed in this way when the fraction to be taken away is less than the fraction of the number to be subtracted from, as $1\frac{3}{4}-\frac{1}{3}$; the common denominator is 12. $1\frac{3}{4}=1\frac{9}{12}$: $\frac{1}{3}=\frac{4}{12}$; thus $\frac{4}{12}$ from $1\frac{9}{12}=1\frac{5}{12}$. When the subtracting is greater, as $7\frac{1}{3}-\frac{3}{4}$, after reducing the fractions to twelfths, one unit is borrowed from the greater number 7, when the subtraction is proceeded with as above.

To multiply a fraction by a whole number, multiply the numerator by the whole number, and place the result as a new numerator over the denominator. When both numbers are fractions, we multiply the numerators together for the new numerator, and the denominators for the new denominator, $\frac{2}{3}\times\frac{1}{5}=\frac{2 \times 1}{3 \times 5}=\frac{2}{15}$. When one or both numbers are mixed numbers, reduce to improper fractions and proceed as above.

To divide a fraction by a whole number, divide the numerator or multiply the denominator of the faction by the whole number. To divide a whole number by a fraction, we invert the fraction, i.e., change numerator for denominator, and multiply. To divide a fraction by a fraction, invert the divisor and multiply the dividend by the inverted fraction, thus $\frac{3}{4}\div\frac{5}{7}=\frac{3}{4}\times\frac{7}{5}=\frac{21}{20}$. When we have mixed numbers, we reduce to improper fractions and proceed as above.

A compound fraction is one whose numerator or denominator is a fraction, as $\frac{\frac{3}{4}}{\frac{5}{8}}$. In adding, subtracting, multiplying or dividing, reduce compound fraction to simple, and then proceed as above, thus:

$$\frac{\frac{3}{4}}{\frac{5}{8}}+\frac{1}{2}=\ \frac{\frac{3}{4}}{\frac{5}{8}}=\frac{3}{4}\times\frac{8}{5}=\frac{24}{20}.\quad \frac{24}{20}+\frac{1}{2}=\frac{24+10}{20}=\frac{34}{20}=1\frac{7}{10}.$$

Decimal fractions are fractions whose denominator is 10, or some power of 10, as 100, 1000, etc., and this denominator is not written but expressed by the means of a point placed to the left of the numerator, and called the "decimal point," or "point," thus $\frac{25}{100}$ is written .25. When the number of figures in the numerator is less than the number of ciphers in the denominator, we place enough ciphers to the left of the numerator to make up the number in the denominator, thus $\frac{5}{100}$ is expressed in decimals as .05. When the fraction is a mixed number as $3\frac{1}{10}$, write the whole number 3, then the point and the fraction, thus 3.1. $478\frac{962}{10000}=478.0962$. In the second case, we have three figures in the numerator and four in the denominator, and put one cipher between decimal point and the first figure in the numerator. In expressing decimals as common fractions, place figures to the right of decimal point as numerator, and for denominator 1 followed by as many ciphers as there are figures to the right of the point, thus $.45=\frac{45}{100}$. To express a common fraction as a decimal, divide the numerator by the denominator, affixing ciphers to the numerator until there is no remainder, or it appears that there will be no remainder, pointing off as many figures in the decimal as there were ciphers added to the numerator; thus $\frac{1}{5}$, by adding one cipher to the numerator and dividing by $5=.2$. In the case of $\frac{1}{50}$ two ciphers have to be added to the numerator, making the result .02. In case of such fractions as $\frac{1}{7}$, where the answer does not end, we would place the point at .1428, using only as many figures as are necessary for exactness.

To add or subtract decimals, write them under each other, with the decimal points in one line, then add or subtract as with whole numbers, and place the decimal point in the answer under its position in the column. To multiply decimals, multiply as with whole numbers, and point off in the answer as many decimal points as there are in both factors taken together. To divide decimals, divide as with whole numbers, and point off as many places as the dividend has more than the divisor.

A decimal which does not end, such as .3333 — — —, which is decimal of $\frac{1}{3}$, is a repeating or recurring decimal, and it is sufficient to carry to four places, thus .3333. It is sometimes written with a dot above the numerator repeating, as $.\dot{3}$, showing that it repeats.

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* Paper read before Hamilton No. 2, C.A.S.E.

SPARKS.

Ingram & Donaldson are installing an electric light plant at Wroxeter, Ont.

An electric light plant has recently been installed in the hosiery mill at Kingston, Ont.

Cronkhite Bros. have installed an electric light plant in their woollen mill at Thessalon, Ont.

An electric light plant for the town of Thessalon, Ont., is said to be under consideration.

The ratepayers of St. Thomas, Ont., have voted in favor of an electric fire alarm system, to cost $4,000.

D. Roche & Co. purpose installing 75 additional incandescent lights in their establishment at Newmarket, Ont.

The Coaticook Electric Light Company have commenced the erection of a new power house in which they will install their arc machine.

The ratepayers of the town of Almonte, Ont., have defeated the by-law to raise $30,000 with which to establish a municipal electric light plant.

Patrick O Toole, assistant electrician of the city of Halifax, N.S., was killed on October 14th by touching a live wire while doing some repair work.

The West Kootenay Light and Power Company have ordered another 30 h.p. three phase induction motor from the Canadian General Electric Company.

The Canadian General Electric Company are installing an electric lighting plant of 150 lights capacity for the Georgian Bay Cement Co., of Owen Sound, Ont.

The Strathroy Electric Company has refused an offer made by the council of 23 cents per lamp per night for 15 arc lamps of 2,000 candle power, on a three years' contract.

The Canadian General Electric Company are furnishing the Montreal Street Railway Company with 20 of their standard General Electric 100 railway motors.

It is said that the American visitors at Murray Bay, Que., purpose organizing a company to establish an electric plant for lighting Murray Bay, Pointe a Pic and Cap a l'Aigle.

The corporation of Bothwell, Ont., have made considerable extensions to their electric plant recently, the work having been carried out by the Canadian General Electric Company.

Robert Anderson, of Ottawa, who has been given a contract to light the streets of Arnprior, Ont., has completed arrangements to install the necessary plant in the saw mill of Geo. Malloch.

C. M. B. Lawrence, proprietor of the Oakville Electric Light Company, has purchased from the Canadian General Electric Company one of their standard single phase alternators of 1,000 lights capacity.

The General Engineering Company of Ontario has been given permission to increase its capital stock from $40,000 to $750,000. The St. Thomas Gas Company will increase its capital from $60,000 to $100,000.

A member of the Board of Trade of St. John, N. B., has given notice of motion to appoint a committee to consider the expediency of municipal ownership of gas lighting, electric lighting, and street railway transportation in that city.

The Montreal Cotton Company, of Valleyfield, Que., are continually increasing their factory power plant, and have just placed another order with the Canadian General Electric Company for six 50 h.p. and one 100 h.p. induction motors.

The village council of Weston, Ont., has accepted the tender of the Canadian General Electric Company, Toronto, for electrical apparatus, and that of the Goldie & McCulloch Co., Galt, for engine and boiler for electric light plant. The total cost is $6,690.

The Hospice St. Joseph de la Delivrance, of Levis, Que., is about to build an aqueduct, for which plans have been prepared by David Ouellet, architect, of Quebec. There will be 5,500 feet of cast iron piping, with brass valves, etc. A hot air engine will be used to raise the water in the building.

The Royal Electric Company, of Montreal, are installing in the head office of the Merchants Bank of Canada, of that city, two 50 k. w. direct connected generators, with Robb-Armstrong engine, complete with switchboards. These generators are to operate at 250 volts, and the building is wired for lighting to operate lamps at 220 volts and also two Sprague elevators. We believe this is the first complete electrical installation in Canada fitted out with 220 volt lamps.

At a recent meeting of the city council of Hull, Que., a motion was submitted to enter into negotiations with the Hull Electric Co. or the Ottawa Electric Co. to light the streets of the city. It was decided to leave the matter in abeyance until the legal dispute now pending between the two companies is settled.

According to the New Westminster Columbian, a company has been organized at New Westminster, B. C., for the purpose of manufacturing electric light carbons. We are told that they have secured water power rights on Stave river and will transmit electric power to the proposed works in New Westminster.

The town of Paris, Ont., is to have a second electric light plant, Mr. W. H. Meldrum, with a number of local people, having formed a new company. They have purchased a complete outfit, consisting of Leonard Ball engine and boilers, and from the Royal Electric Company a complete S.K.C. two-phase plant, the dynamo having a capacity of 50 k.w. The work of installing the new plant is now under way.

Regarding the market for mica in Australia, Mr. J. S. Larke, of Sydney, in a report to the Dominion Government, says: "Some ground or rather finely broken mica is used here for making a covering for steam pipes. It at present comes from India, where £8 per ton is paid for it. As there may be considerable refuse mica in Canada from which this article is made, I send a sample of the article with this report."

The Soulanges canal connecting lakes St. Francis and St. Louis, in the province of Quebec, has been completed, and was officially opened last month. The length of the canal is 14 miles. Nine miles from the lower end is situated the power house, where 500 horse power is developed, under a head of 20 feet, and used for generating electricity for lighting the canal and for operating the bridges, sluice gates, etc. The electrical apparatus in the power house was furnished by the Canadian General Electric Co., of Toronto, and the water wheels by the Stillwell-Bierce & Smith-Vaile Company, of Dayton, Ohio.

The Canadian General Electric Company have just received an order from the Trenton Electric Company for a 75 light equipment of their alternating series enclosed arc lamps, with automatic regulating transformer and switchboards. These are to be used for lighting the streets of the city of Belleville, Ont., the current being taken from the three phase transmission lines coming from Trenton, a distance of 13 miles, where the power is generated. This is the third installation of this kind which is being put in in Canada, 100 lights capacity having been installed in Sherbrooke, Que., and 100 lights in Halifax, N.S., both of which are giving eminent satisfaction.

The Trent River Paper Company, of Frankford, have placed an order with the Royal Electric Company for one of their 40 k.w. S.K.C. two-phase generators, with full complement of transformers and supplies. It is the intention of this company to not only light their own large premises, but also the following villages, viz.: Frankford (one mile distant), Stirling (nine miles distant), and possibly Foxboro and Wooler (six miles distant). Work of excavation for the new mill of this company was commenced on the 27th of May last, and the fact that within the next two weeks this company will be making paper is an evidence of the capabilities of the genial manager, Mr. Walter S. Miller.

Canadians will be interested in learning that Prof. Carus-Wilson, late professor of electrical engineering at McGill University, Montreal, and who is now in England, is preparing plans for an undertaking having for its object the utilization of the tunnel which some years ago was constructed in the heart of London. This tunnel was built in 1859 by the Pneumatic Despatch Co. for the purpose of carrying mails and parcels from the general post-office to the North-western Railway station by means of an underground chute, but the difficulties of utilizing pneumatic pressure on such a large scale proved insuperable. The idea was that a train of cars heremetically fitting the tube should be pumped from the post-office to Euston. Sufficient allowance, however, was not made for air leakage and other disadvantages, and after increasing the horse power from 300 to 800 horse power, the scheme failed, and $850,000 lay wasted underground. Recently an enterprising engineer conceived the possibility of accomplishing by means of electrical traction that which could not be done with compressed air, and with this end in view the services of Prof. Carus-Wilson have been retanied. He is said to be preparing plans for fitting the tube, which is two miles long, with an electric train and lighting it with incandescent lamps. The proposed train will draw four cars, each carrrying nine tons, at the rate of from 25 to 30 miles an hour.

SPARKS.

Geo. Thompson, of Belleville, has installed an electric light plant in the drill shed in that city.

The city of Belleville, Ont., will likely install an electric fire alarm system, for which tenders will shortly be invited.

The name of the Montreal Island Belt Line Railway Company has been changed to the Montreal Terminal Railway Company.

Messrs. T. J. Duncan and W. A. McDonald, of Rossland, B. C., have applied for incorporation of the Rossland & Sophie Mountain Electric Railway Company.

The first electric tramway in China has been opened for traffic. It extends from the Pekin railway station at Machiapu to the south gate of the capital, a distance of four miles.

The Ashcroft Water, Electric Light & Improvement Co., of Ashcroft, B.C., purposes installing additional electrical apparatus with a view to furnishing light and power for mining purposes.

The Dominion Cartridge Co., Lachute, Que., are increasing their electric lighting plant, and have placed their order for a 20 k.w. generator and switchboard with the Royal Electric Company, Montreal.

The Richmond Electric Company, of Richmond, Que., have installed a second 75 k.w. S.K.C. generator to meet the increasing demand for electric lights. They have also installed a number of motors, from 5 to 15 h.p., which operate from the S.K.C. system.

The Pacific Coast Power Co., Limited, has been granted a provincial charter, to construct a dam across Powell river in New Westminster district, and to convey water to some point on the sea-coast to be used for the development of power. The capital of the company is $50,000.

The Grand Forks Water, Power & Light Co., of Grand Forks, B.C., has submitted the details of its undertaking to the government. It is proposed to build a dam across the north fork of Kettle river about one mile from Grand Forks, and to construct a flume to carry the water to the point of development. Work must be in commenced within twelve months.

Prof. Rutherford Macdonald, Professor of Physics at McGill University, Montreal, recently gave the first of a series of lectures on "Electric Waves and Oscillations." Prof. Rutherford has made considerable research work in this subject, and some years ago devised an apparatus with which he could transmit messages a distance of half a mile without any connecting wire.

Since Saturday, the 21st of October, the town of Dundalk has been basking in the rays of the electric light, their new plant being started on that day. The plant is owned and operated by the municipal council, and consists of Leonard engine and boilers and an S.K.C. 30 k.w. dynamo. The streets are lighted with incandescent lamps and make a very attractive appearance.

Mr. R. G. McLean, of Toronto, has given a contract to the Waterous Engine Company, of Brantford, for a 50 horse-power McEwen engine for his printing establishment, to be installed immediately. This will replace the 30 h.p. Wheelock engine now in use, Mr. McLean's business having so increased as to demand additional power. His steam plant is under the superintendence of Mr. H. E. Terry.

The Montreal Street Railway Company have appealed against the assessment of their poles, wires and rails under the new tax imposed in the city charter. The assessment placed upon these is $280,000. The company have 96 miles of single track, making the valuation $3,000 per mile. The company claim that the valuation for a similar tax in the city of Toronto is only $1,050 per mile, and they ask that their assessment be reduced accordingly.

The steamer Sardinian, which is transporting the Canadian contingent to South Africa, is well supplied with artificial illumination for "The Soldiers of the Queen." The Royal Electric Company, of Montreal, started to install a complete electric lighting equipment on this steamer on Saturday, October 21st, and turned over the plant, consisting of one 20 k.w. direct current generator, with 325 lights installed, complete in operating condition, on Thursday, October 26th.

The Niagara Central Railway Company have commenced the conversion of the road between St. Catharines and Niagara Falls into an electric line, and it is expected that cars will be running by January 1st. The cars are being built by the Ottawa Car Company, and will be 50 feet long, with baggage and smoking compartments and accommodation for forty-eight passengers. They will be heated by steam, supplied with Nightingale air brakes, and will rest on double trucks.

TRADE NOTES.

The Geological Survey Department of the Dominion Government have ordered a large iron show case from the Goldie & McCulloch Co., Limited, Galt, Ont., for the Paris Exposition.

Messrs. Richardson & Sons, Bedford, N.S., have purchased a complete electric lighting plant for their factory from the Royal Electric Company. The Maritime Electric Co., of Halifax, are making the installation.

The Goldie & McCulloch Co., Limited, Galt, Ont., have recently received some very nice orders for wood-working machinery from the Maritime provinces. They are also busy on orders for similar machines for different parts of Ontario.

The Goldie & McCulloch Co., Limited, Galt, Ont., have just completed and shipped to Mexico, via Vera Cruz, 15 large bagasse filters for sugar plantations there. They also have a large order for special machinery for the St. Charles Condensing Co., a United States firm who are opening a Canadian branch manufactory at Ingersoll.

The Palmerston Carriage Company, Limited, of Palmerston, Ont., have decided that the old-fashioned kerosene lamps are not good enough for them, and have placed their order with the Royal Electric Company for a complete electric lighting equipment, consisting of a 100-light dynamo, switchboard, and all necessary wiring throughout the factory.

Readers of the ELECTRICAL NEWS are reminded that Mr. C. E. Shedrick, of Sherbrooke, Que., is still manufacturing the Whitney electrical instruments for Canada, as well as the Wright discount meters. Mr. Shedrick reports that he has orders on hand far in excess of the capacity of his factory, but next spring he hopes to overcome this drawback by enlarging his buildings and plant.

The Ogilvie Milling Company have contracted with Sadler & Haworth, manufacturers of leather belting, of Montreal and Toronto, to supply them with a mammoth leather belt for their new mills at Winnipeg, Manitoba. It will be 72 inches wide, three ply thick, and over one hundred and thirty feet long. This belt, when finished, will be the widest and heaviest leather belt in use, or ever made in Canada.—Toronto Globe.

Messrs. Ahearn & Soper, of Ottawa, have closed contracts within the last few weeks for nearly 5,000 h.p. in Westinghouse induction motors for use in the city of Montreal. The motors will be operated from the circuits of both the Royal Electric Co. and the Lachine Rapids Hydraulic & Land Co. The contracts include a 100 h.p. motor for operating the new factory of the Dominion Oil Cloth Co., a 20 h.p. motor in Peter Lyall's stone works, three motors of 5 to 15 h.p. in the new factory of the Wire & Cable Co., and about twenty motors running from 50 to 300 h.p. each for the mills of the Dominion Cotton Co. The motors in each case are of the Westinghouse Tesla induction type.

MOONLIGHT SCHEDULE FOR NOVEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 5.30	A.M. 5.30	12.00
2....	" 5.30	" 5.30	12.00
3....	" 5.30	" 5.30	12.00
4....	" 5.30	" 5.30	12.00
5....	" 5.30	" 5.30	12.00
6....	" 6.30	" 5.40	11.10
7....	" 7.30	" 5.40	10.10
8....	" 8.40	" 5.40	9.00
9....	" 9.50	" 5.40	7.50
10....	" 11.00	" 5.40	6.40
11....	" 11.00	" 5.40	6.40
12....	....	" 5.40	5.30
13....	A.M. 12.10	....	
14....	" 1.20	" 5.50	4.30
15....	" 2.30	" 5.50	3.20
16....	No Light.	No Light.	.....
17 ...	No Light.	No Light.	.....
18....	No Light.	No Light.	.....
19....	No Light.	No Light.	.....
20....	P.M. 5.10	P.M. 8.30	3.20
21....	" 5.10	" 9.30	4.20
22....	" 5.10	" 10.30	5.20
23....	" 5.00	" 11.30	6.30
24....	" 5.00	A.M. 12.30	7.30
25....	" 5.00	" 1.00	8.00
26....	" 5.00	" 1.30	8.30
27....	" 5.00	" 2.30	9.30
28....	" 5.00	" 3.30	10.30
29....	" 5.00	" 4.30	11.30
30....	" 5.00	" 5.30	12.30
		Total.........	212.20

THE EFFICIENCY OF 220-VOLT LAMPS.

The Elektro Technische Rundschau quotes the results of some experiments recently carried out in Karlsruhe to ascertain the life and efficiency of 220-volt incandescent lamps. No less than six different makes of lamp (all German, it is presumed) were subjected to the test, the first measurements with the photometer taking place after the same had been burning 15 hours, when the energy consumed was also determined. Subsequent to these measurements the lamps were subjected to an endurance test on a 220-volt circuit. After 344,702 and 1,150 working hours respectively, measurements were again taken to determine the energy consumed and the candle power of the lamps. The graphic representations of the values so discovered show that the lamps, when new, consumed from 3.8 to 4.3 watts per candle, while the actual candle power of 16 c.p. (nominal) lamps amounted to between 11.4 c.p. and 14.9 c.p., that of 10 c.p. (nominal) lamps being only 8 c.p. After 600 working hours the 16 c.p. lamps were found to consume four to five watts per candle power, the intensity of the light given varying between 11.7 c.p. and 14.2 c.p. Thus, says the Electrical Engineer, the test proved anything but favorable relative to the bulk of the samples. The energy consumed is considerable compared with lamps of lower voltage, and the candle power decreases rapidly with the hour's run. This is especially the case with 10 c.p. lamps, which must, indeed, be termed unserviceable. Individual lamps supplied by the same firms differed considerably, both as regards candle power and efficiency, which must be ascribed to careless grading. A variation in the voltage amounting to 1 per cent. effected a change in the candle power of 6 to 7 per cent., which agrees with observations repeatedly made in regard to 110-volt lamps. In conclusion, it is remarked that the introduction of high voltage lamps will be of little advantage so long as their efficiency remains so much behind that of ordinary lamps.

Here is part of the Montreal Transvaal Company, now en route to South Africa: H. H. Walker, age 25, 54th Battalion, Richmond, electrician, birthplace Stockport, Eng.; D. Middleton, age 27, Prince of Wales' Fusiliers, electrician; Michael Kelly, age 22, Prince of Wales' Fusiliers, electrician, birthplace Ottawa.

PUBLICATIONS.

Catalogues received during October include a very complete one from the Brown & Sharpe Manufacturing Company, manufacturers of machinery and tools, Providence, R.I.

Messrs. Wilber B. Driver & Co., of 126 Liberty street, New York, have issued a useful booklet entitled "Resistance Wires," which contains many useful tables of the resistance, temperature, coefficient, spacific gravity, etc., of their well known makes of wire. These include the "Climax," "Adamance," "D" and "Hercules" binding wire.

Two hundred and twenty pages represent the number contained in the October issue of the Street Railway Review of Chicago. This is a souvenier number, issued just previous to the annual meeting of the American Street Railway Association held in Chicago from October 17th to 20th. The issue reflects great credit upon the publishers. The letter-press pages are replete with half-tone illustrations pertaining to Chicago and to the various railway enterprises in the vicinity, which include every type of motive power, horse cars, cable cars, trolleys, third rail, three-phase, storage battery and compressed air systems. During the progress of the convention the publishers of the Street Railway Review issued a daily edition containing full information concerning the programme of the day and an account of the previous day's session.

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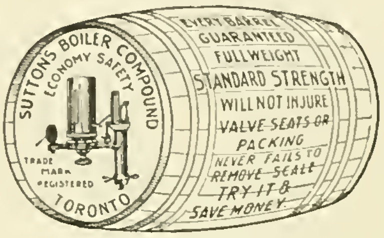

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FEATURES WORTH REMEMBERING

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RECENT PLANTS INSTALLED:—Lachine Rapids Hydraulic & Land Co., Montreal, Que., 12,000 h.p.; Chambly Manufacturing Co., Montreal, Que., 20,000 h.p.; West Kootenay Power & Light Co., Rossland, B.C., 3,000 h.p.; Dolgeville Electric Light & Power Co., Dolgeville, N.Y.; Honk Falls Power Co., Ellenville, N.Y.; Hudson River Power Transmission Co., Mechanicsville, N.Y.; Cataract Power Co., Hamilton, Ont.

CORRESPONDENCE SOLICITED.

The Stilwell=Bierce & Smith=Vaile Co. = *DAYTON, OHIO. U. S. A*

Scientific American, Oct. 14, 1899.

The Automobile Magazine has at last come to hand and is the most thoroughly satisfactory periodical which we have seen in any language on the subject. It is of regular magazine size and has 111 pages. The quality of the articles is very high and the illustrations are of the best. Everyone who is at all interested in the automobile will find something in the new magazine which will interest him. Even the social side is far from being neglected, as there is an article on the recent floral parade at Newport and on the Automobile Club of France. The Automobile Index, which occupies some nine pages, is exactly what has been needed. On the whole the magazine is a most satisfactory one.

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$3.00 A YEAR.

N. Y. Evening Post, Oct. 9. 1899.

The new illustrated Automobile Magazine (New York: U. S. Industrial Publishing Co.) has a very attractive appearance, and is so varied in contents, without undue padding, that one wonders how the editor can fill his pages hereafter. Still, the list on page 101 shows that there is a considerable "foreign automobile press;" and what foreigners can do in the way of furnishing "copy" to the printer, Americans can. The society feature of the new vehicle is brought to the front with news from the Newport festival—the driver, by the way, not always sitting on the left. There are competent-seeming book reviews, and some concessions are made to the general reader in comicalities of pencil and verse. The magazine seems free from bias.

CANADIAN
ELECTRICAL NEWS
AND
ENGINEERING JOURNAL.

VOL. IX. DECEMBER, 1899 NO. 12.

AN ELECTRIC HEATING AND COOKING PLANT.

In their new hospice building at Niagara Falls, Canada, the order of the Carmelite Fathers have installed a modern electrical plant for lighting, heating and cooking purposes. This plant has taken the place of all other kinds of fuel for cooking and heating in the building, no less than 100 horse power being used for the various purposes.

The building in which this plant is installed is 200x250 feet, the distance from the ground to the top of the tower being 85 feet. The following particulars of the electrical equipment are found in the Electrical World:

The current used by the Carmelite Fathers is obtained from the Canadian Niagara Power Company. It is generated in the station of the Niagara Falls Park and River Railway, where the Canadian Niagara Power Company has installed a temporary plant pending more elaborate development under its franchise privileges, in order that the Canadian side of the river at the Falls may have all the electrical power called for in factories and other places. The power station is located about two miles from the hospice, and the current is carried over No. 3 bare copper wire strung on a pole line. The transformer house of the hospice plant is a small wooden building located about 150 feet from the main building. It contains two 30-k.w. Westinghouse and one 25 k.w. General Electric transformers, primary 2,200 volts and three-phase secondary 110 volts, current being transmitted through underground cable to the switchboard in the main building. The switchboards are located in the basement. A switchboard with double-throw switches controls two phase of the current, and the third phase is controlled by a switchboard adjoining the first one, and is used for cooking, lighting, etc. The two switchboards are so arranged that either transformer can be used independent of the other for either purpose.

In the hospice building there are 200 16-c.p. incandescent lights, the current supply of which is taken from 25 horse power used for this purpose, for cooking and for heating water. The total amount of power taken by contract is 100-h.p., and the other 75-h.p. is applied to heating the lower floor of the hospice building, which comprises 11 bed rooms, a dining room, reception room

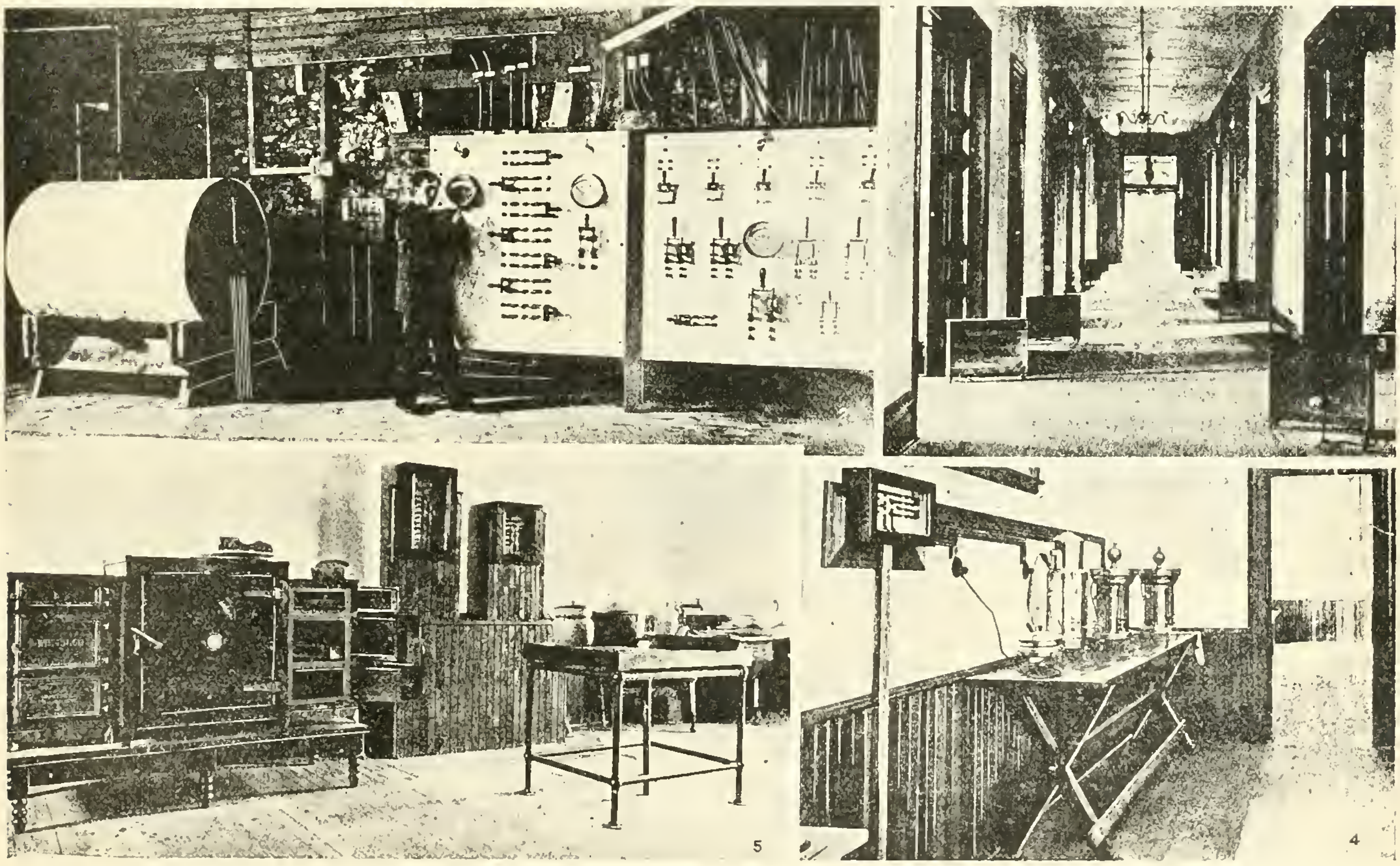

Fig. 2.—Electrically Heated Boiler. Fig. 3.—Corridors. Fig. 4.—Butler's Pantry. Fig. 5.—Electric Kitchen.

ELECTRIC HEATING AND COOKING EQUIPMENT IN CARMELITE HOSPICE, NIAGARA FALLS, ONT.

and office, and the corridor. This corridor is 120 feet long, 10 feet wide and 15 feet high. In it are installed nine 4-h.p. heaters. Each of the bed rooms is 10 by 12 by 15 feet and in each one there is one 4-h.p. heater with a changeable heat switch of two heats.

The kitchen of the hospice is equipped with an electric combination range and three electric ovens. This range has a heating surface of six square feet, each square foot of surface consuming 15 amperes and having a switch that allows the current to be controlled at full or half heat. Of the three electric ovens two of them are small and one large. Each of the small ovens has three compartments, and consumes 23 amperes of current at 110 volts, while the large oven takes 50 amperes. This oven equipment is so arranged that four 25 pound roasts can be handled at one time.

In the butler's pantry there are electrically operated urns and a chafing dish. The urns are three in number, each of five gallons capacity. One of the urns is used for making tea, one for making coffee, and the other for heating water for use in the tea and coffee urns.

Down in the basement, standing close by the switchboards and in the same room, there are two boilers electrically operated. One of these has a capacity of 400 gallons, while the other has a capacity of 150 gallons. The 400 gallon boiler is used for heating water for laundry and bath room purposes, and takes a current of 120 amperes, being divided in three heats. The small boiler is used for heating water for kitchen use, but can also be used in connection with the large boiler. The small boiler takes 125 amperes, being also divided into three heats. It is used principally for quick boiling. Both of these boilers are covered with 2½-inch asbestos covering. All water is boiled, so far as possible, when current is not being used for other purposes.

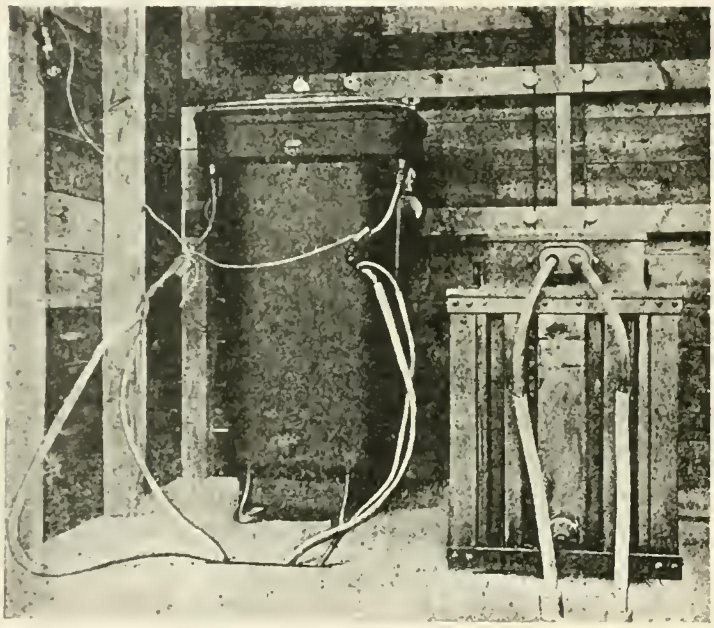

Fig. 1.—Transformer, Carmelite Hospice.

The electrical kitchen has been found capable of most successful operation, and on June 15th, on which day the building was formally blessed by His Grace, the Archbishop of Toronto, the Most Rev. Denis O'Connor, D. D., of Toronto, dinner was cooked for 250 people. This did not include the soups, which, owing to their taking hours of time in their manipulation, were prepared in the kitchen the day before. But all meat and other food were cooked electrically that day. In the big boiler it is possible to heat from 60 degrees to 212 degrees in six hours with full heat. In the small ovens bread can be baked in 18 minutes. On the door of the big oven is a barometer which shows the heat and indicates the temperature through the different times of roasting and baking. The heat of the ovens is kept uniform from the start to the finish of the cooking.

The current used for water heating, cooking and lights costs $25 per h.p. or $625 a year, while the 75 h.p. used in heating the corridor and bedrooms is secured at about one-fifth this price per h.p. It is evident that the heating service is not in use only during certain months of the year, and in addition to this the power is obtained from a station where in winter time there is a surplusage, owing to the fact that not as many cars are operated in winter on the scenic line as during the summer time. But one important feature demonstrated to the owners of the plant during the past winter was that a combination fuel and electric hot water heating installation might be found more serviceable under present conditions than the separate electrical installation, for much trouble has been experienced on the Canadian side in winter in the matter of power development from anchor ice, in fact during last winter the ice was very troublesome on both sides of the river. At times the current was entirely cut off, and at such times and under such circumstances a fuel service under the boiler to heat water for general heating purposes would have been deemed ideal. The plant of the hospice was installed by Mr. A. Harth, and he has expressed a belief that such a system of heating would be most advantageous not only at Niagara but in other places where people seek to use electricity for heating purposes, whether in factory or residence. The idea thus expressed is, that instead of carrying the current through the building to heaters located here and there, it might, in many cases, be better to install a hot water heating plant and apply all the current to the boiler for heating the water for circulation through the building, and where the electric service is for any reason likely to be cut off have a fuel service at the boiler ready for immediate operation.

No doubt many other new ideas will be developed at Niagara in the matter of using electricity for heating, but the plant in the hospice has given great satisfaction, and is the wonder of all who see it. One very noticeable feature of the kitchen is the entire absence of dirt and soot on the various utensils used on the stove or in the ovens. The plant as a whole requires but little care for its operation and management.

[Since the above was written the power house of the Niagara Falls Park and River Railway, from which the current was obtained, has been destroyed by fire.—Ed. Electrical News.]

It appears as if it were only a question of a very brief time, says the Engineering Magazine, before petroleum motors designed upon the principles demonstrated by Diesel, Banki and others will come into general use, not only for small powers, but also for general service.

A motor car is about to be put in operation between Ashcroft and the gold mines of Cariboo, B.C., a distance of 200 miles. The vehicle is now being built in Vancouver, and will be completed early in the spring. It will have accommodation for twelve persons, besides 1,000 pounds of freight, and if its operation is successful other carriages will be put on the line. Steam will probably be used as the motive power.

BY THE WAY.

We have become accustomed to the phrases "The Sturdy West" and "The Effeminate East" as applied respectively to the new and older provinces of Canada. These phrases express the truth that battling with difficulties incident to the development of a newly settled country develops a sturdy and self-reliant manhood, while, on the contrary, the easy conditions prevailing in more highly civilized communities tends to weaken in men these desirable qualities. I was reminded of this fact by a recent conversation with a young man who has grown up with one of our western towns, and for quite a number of years has been identified with the electrical business. He had few advantages for the acquirement of technical knowledge, but lost no opportunity of improvement, and has fought his way up through many difficulties to an important and responsible position. When the street railway generators burned out, and the man in charge declined to undertake their repair, this young man was asked if he could do the job. Although having but a very limited knowledge of the machines, he promptly answered "yes." So dubious were the owners regarding his ability that they offered to pay him a fixed sum (not a very liberal amount) if he succeeded, but with the provision that he must furnish his own material, so that they might be put to no risk. It took two or three days and much worry to complete the work, but the young man was determined to succeed, and he did. In telling me the story he said: "Many of the young men I meet are too ready to say 'I can't' when a difficulty arises, and it is therefore not surprising that some who have been eight or ten years connected with electric stations, have made little or no advancement. They have not shown their employers that they are capable of doing the things which would earn for them promotion. The ease with which, in cities, someone can be got to make repairs, is a stumbling block in the way of young men, who under less advantageous conditions would be compelled to use their own hands and brains in overcoming difficulties. Another obstacle in the way of the young man's progress in the east, is pleasure in its many alluring forms, which makes it difficult for those not blessed with large powers of determination to pursue the more rugged and profitable path of duty."

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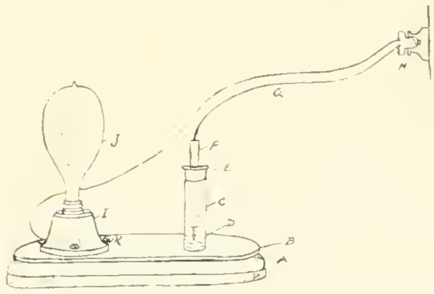
"It's surprising how Canadian business men allow themselves to be 'taken in' by Yankee sharpers," said the manager of a large industrial concern with whom I conversed recently. He went on to tell how a gentleman from across the line had brought into Canada what was claimed to be an entirely new method of lighting, designed to throw into the shade the present arc and incandescent systems. On the strength of his claims and his ability to produce a brilliant light some business men, including, strange to say, a lawyer, were induced to give up some of their hard earned dollars to assist in developing the enterprise. At this stage the idea occurred to the lawyer that it might be advisable to get the opinion of a friend of his who was qualified by experience to judge of the value of the new discovery. Accordingly a visit was made to a bicycle repair shop, where the invention was in operation. In reply to the enquiries of the lawyer's friend the inventor began a description of the modus operandi of his system, which, as a certain writer has expressively put it, was "as clear as mud," and was intended to pull the wool over the eyes of the uninitiated. The lawyer's friend did not, however, belong to this class. He took in the situation at a glance, and mentally stamped the word "humbug" in large letters on the whole outfit. What he saw was this: An iron receptacle resembling the upper part of a kitchen boiler, filled two-thirds full of a liquid which the sense of touch and smell declared to be coal oil. The space above this liquid was filled with air pumped in with a hand pump. Attached to the tank were small pipes through which the oil was forced by the pressure of the air in the tank, and discharged into the bottom of a vertical pipe of larger diameter heated to a high temperature, contact with which served to transform the oil into gas. The gas on rising to the top of the pipe became mixed with air supplied from pipes opening into the atmosphere. The gas and air thus commingled then passed downward and were fed into a group of Bunsen burners fitted with Welsbach mantles which were thereby heated to incandescence. The system embodied no new principle but simply accomplished by a very round about method what has been done for years by the direct use of gas and the Bunsen burner. The enterprising promoter, on realizing, by the questions and remarks of the lawyer's friend, that the bubble had been pricked and that he would be called on to refund the advances made to him, or in default face the courts, pleaded the receipt of a telegram urgently requiring his presence at home, as a reason for taking his hasty departure.

CIGAR AND PIPE LIGHTER.

A correspondent sends the Electrical News the accompanying drawing showing a cheap and simple form of cigar and pipe lighter for alternating or direct current circuits—any voltage,—with the following explanation:



A—Wood base.
B—Mica or asbestos veneer.
C—Small wide mouthed phial.
D—Wood alcohol or methylated spirit.
E—Cork; hole drilled through centre.
F—Piece of vulcanized fibre rod, drilled through.
G—No. 16 cotton incandescent cord, one end passed through fibre rod and insulation removed at exit from rod.
H—Pony wall receptacle, with fused attaching plug.
I—Pony wall receptacle, other terminal of No. 16 cord connected to one side clamp.
J—32 c.p. or 50 c.p. lamp, voltage—same as current supply; base to suit receptacle I.

To operate, wipe end of rod F across free receptacle clamp K and spirit absorbed will be kindled instanter. If done fairly quickly the lamp J will not even light up.

The town of Yarmouth, N.S., is furnished with water pumped by electricity, the current being supplied by the Yarmouth Street Railway Co., at a cost of $200 per month. The company have notified the corporation that they cannot continue to furnish the power at this figure after February 7th, 1900, and consequently the council is considering the advisability of putting in a steam plant to furnish power for pumping, and also for operating a dynamo for street lighting. The services of an electrical engineer will be engaged to give advice on the subject.

CORRESPONDENCE.

THE FIRST 220-VOLT PLANT.

TORONTO, Nov. 9, 1899.

Editor Canadian Electrical News.

DEAR SIR, —In your November issue we notice an item stating that the Royal Electric Co. are installing a 250-volt plant in the head office of the Merchants Bank of Canada, and that it is believed to be the first complete installation in Canada fitted out with 220-volt lamps. We beg to state that last September we installed a complete 250-volt direct connected plant for Messrs. Gowans, Kent & Co., in this city, which in addition to operating three elevator motors, is operating four hundred 250 volt incandescent lamps. We believe this to be the first complete installation in Canada using 250 volt lamps, as the Merchants' Bank plant has not yet been installed.

We enclose copy of letter from Messrs. Gowans, Kent & Co., which explains the satisfaction derived from the above plant purchased from us.

Yours truly,
UNITED ELECTRIC Co., Limited.

TORONTO, Nov. 8, 1899.

UNITED ELECTRIC Co., Ltd.:

GENTLEMEN,—We are pleased to say that the electric plant which you installed for us in September last, consisting of 30 k.w. multipolar generator direct connected to 9 x 10 Robb engine and Mumford boiler, is giving the best of satisfaction. We are glad that we followed your suggestion to adopt the 250 volts presure instead of 110 volts as contemplated, thus enabling us to operate our light and motors jointly, with greater economy, and also to connect our circuits at any time to the commercial power circuit should we not desire to operate our engine.

We heartily recommend the adoption of this system for isolated power and lighting plants, and you are welcome to bring prospective customers to examine our plant.

Yours truly,
GOWANS, KENT & Co.

THE MONTREAL ELECTRIC CLUB.

MONTREAL, Dec. 4th, 1899.

Editor ELECTRICAL NEWS.

DEAR SIR,—"Club's" letter in your November number recalls some pleasant recollections of our late Montreal Electric Club. There has not been, nor is, to the writer's knowledge, any other electric club here which exactly fills the place that this one used to occupy. Not until the club had terminated did the members really appreciate the benefit of those evenings. The writer, for one, gained valuable instruction from the various papers, discussions, debates and lectures. We met once a fortnight.

It must be remembered that in those days electrical applications were not nearly as widespread as they are to-day; the street railway was changing over from animal power; incandescent lighting was being introduced; arc lights were fewer; telephones were scarce; house bells a wonder; interior wiring a matter of individual taste, no rules being enforced or practiced; no college course could be had here that was of any use. We were seeking or experimenting for knowledge for our daily needs, and whenever we could get some visiting or well known expert to come before us, didn't we just pump him all we could.

The social side of the club was also important. The evenings were unspoiled by useless formality—merely a simple order of proceedings was observed.

One of the most interesting features of our evenings was the debates. These, at first, tried with hesitation, ended by becoming the best attended meetings, and it seems amusing now to think of the nerve with which we talked on leading questions of the day.

"A FORMER MEMBER."

USE OF ENCLOSED ARC LAMPS.

MR. L. B. Marks contributes to the Electrical World and Engineer some statistics showing the rapidity with which enclosed arc lamps have come into use. Up to 1895 open arc lamps were used very largely, but that year marked the turning point in arc lamp practice, brought about by the introduction of the enclosed arc lamp, which bids fair to almost entirely supersede the open type. In the year 1895 the number of open arcs in use was greater than those of the enclosed type, but has since dropped rapidly each year. The records for thirty-two cities in the United States show that in 1896 there were in use 23,605 open arc lamps and 1,203 enclosed arc lamps, while in 1899 the number of open arcs in use in these cities was 16,010 and the number of enclosed arcs 20,848. These figures show a decrease of open arcs in three years of thirty-two per cent., and an increase in enclosed arcs of 1,600 per cent. It is estimated that there are now in use in the United States about 150,000 enclosed arc lamps, of which more than half have been installed within the past two years. The total number of enclosed arc lamps in Great Britain and the Continent is given as 55,000, but it should be stated in this connection that the first commercial use of enclosed arcs abroad began about a year later than in the United States.

MR. R. B. WILLIAMSON, M. E.

THE features of Mr. R. B. Williamson, M.E., now principal of the Electrical Department of the International Correspondence Schools, Scranton, Pa., but at one time a resident of Canada, are shown in the accompanying portrait. Mr. Williamson graduated in Electrical Engineering at Cornell University. After graduating he spent two years at electrical construction work, including the complete installation and operation of electric light plants. This work also included the installation of steam engines, and involved a large amount of interior wiring. During the same time he also did considerable designing in connection with dynamos and motors. In 1895 he was chief draftsman for the Canadian General Electric Company, at the same time engaged largely in designing work in connection with dynamos and motors, both for direct and alternating currents. While with that company he gained considerable experience in the construction and operation of street-railway apparatus, together with all kinds of switchboards used in street-railway and power plants. In 1896 he accepted a position as Instructor in Electrical Engineering at Lehigh University, going from that University to the International Correspondence Schools. While at Lehigh University he had complete charge of the courses in dynamo-electric machinery and the design of electrical apparatus. He also had charge of the work in connection with the electric street railways, and did considerable special work on alternating currents.

MR. R. B. WILLIAMSON, M.E.

The School of Electricity of the Colliery Engineer Company, over which he has charge, includes seven courses, as follows: Electrical Engineering, Electric Power and Lighting, Electric Lighting, Electric Railways, Electric Mining, Wiring, and Bellwork.

The Hammond Reef Consolidated Mining Company, Ltd., are installing at their mine a cable derrick which will be operated by a 20 h.p. induction motor. This, together with the generating plant and mill motors, will be in operation within a week. The Canadian General Electric Co., who have the entire contract, have sent their expert to superintend the starting.

REPORT ON TRIALS MADE AT MAGOG, QUEBEC, TO TEST THE ECONOMY EFFECTED BY COMPRESSED AIR.

By Prof. J. T. Nicolson, D. Sc. (Edinburgh and McGill), M. Inst. C.E.

THESE trials were made during the month of April, 1899, at the Dominion Cotton Mill, Magog, Canada, where there is installed a 150 horse power hydraulic air compressing plant on the system devised by C. H Taylor, of Montreal. They were made at the instance of Mr. John A. Inslee, of St. Louis, and conducted under the auspices of Mr. Inslee, the Taylor Hydraulic Air Compressing Co., and the Dominion Cotton Mill Co., jointly.

The trials were conducted by the undersigned, assisted by Professor R. J. Burley, B. Sc., etc., of McGill University, but a number of prominent engineers from the United States were invited to be present and took part in the experiments. Among others I may mention Mr. A. Langstaff Johnson, of Richmond, Va., Mr. William O. Webber, ot Boston, Mass., and Mr. John Birkinbine, of Philadelphia, Pa.

Experiments were made on five different methods of using compressed air in an ordinary steam engine of the Corliss type.

1st. The air was supplied to the engine cold.

2nd. Steam was injected into the air in the main pipe before supplying it to the engine.

3rd. The air was injected among the water in a steam boiler and heated by mixing with the water and steam of the boiler before being supplied to the engine.

4th. The air was blown upon the surface of the water in a steam boiler and heated, by mixing with steam in the same before being made to drive the engine.

5th. The air was passed through a tubular heating vessel and heated by a coke fire, afterwards being used to work the engine.

For all the experiments the air was drawn at a pressure of 53 lbs. from the 5-in. main air pipe of the Taylor air compressor, which supplies power to the mill, and was piped to a 12-in. diameter by 30-in stroke Corliss engine, supplied for the purpose of the trials by the Laurie Engine Company, of Montreal.

A friction brake was fitted on the fly-wheel of this engine and the engine in this way was worked up to its full power at about 75 revolutions per minute.

Connection was made to a Lancashire boiler 7 feet diameter by 30 feet long when it was desired to mix steam with the air for purposes of pre-heating.

When dry heating was resorted to the air pipe was led through a heater on its way to the engine, having been previously blanked off from the steam boiler. This heater was designed by the writer and built by Messrs. The Laurie Engine Co. for these experiments; but, as it was designed of such size as to heat the whole of the compressed air used in the mill, it was considerably larger than was required to heat the greatest quantity of air which could be used by the Corliss engine employed on the test. It was, therefore, a matter of some difficulty to prevent the heater and the small quantity of air passed through the same from becoming hotter than was desired.

For the experiments made without pre-heating the observations made were as follows:

The temperature of the air before entering the engine.

The same on leaving the engine.

The pressure of the entering air, indicator cards from each end of the cylinder, readings of the revolution counter and of the rope break weights.

A trial was conducted with cold air on April 27th, in the presence of Mr. Birkinbine, which gave the following results:

The air entered at 66.5 F. and was exhausted at —41 F., the revolutions being 74.6 and the cut-off about one-third of the stroke. The indicated horse power was 27 and the weight of air used per hour was 1,671 lbs. This gives about 841 cubic feet of free air at 60 F. per i.h.p. hour.

On another trial made under same conditions 850 cu. ft. of free air were used for per i.h.p. hour.

2. In the case of experiments made with the dry heating, the following observations were made:

The temperature of the air before entering the heater; after passing up the first row of tubes; upon leaving the heater; before entering the engine.

The temperature of the furnaces and flue gases of the heater were also taken, the former with a Callendar's patent electrical promoter.

The amount of coke (Sherbrooke gas coke) used was carefully weighed and the trial only began when the conditions had become teady, i.e., about three hours from the time of beginning the run wtth heated air. Cards were taken; the brake horse power and the revolutions were also observed.

With air entering the heater at a pressure of 53½ lbs. gauge and at a temperature of 58.2 F., it was raised to 225 F. after passing the first row of tubes, and 363 F. upon leaving the heater. Owing to undue length of air pipe and lack of proper covering, the air fell in temperature to 287 F. before entering the engine. It was exhausted at 88 F., and the pressure at the engine was 52½ lbs. by gauge.

The temperature of the gases leaving the fire was only about 700 F.—and was reduced to 100 F. in the flue of the heater. It was difficult to use a small enough quantity of coke in such a large heater without letting the fire out altogether. A closed ash pit was used and the air for combustion supplied from the compressed air main and could be regulated to a nicety.

Under these conditions and with exactly the same cut-off as in trial of cold air, the indicated horse power being 26.7 and the revolutions 70 per minute, there used 1,310 lbs. of air per hour; this gives a consumption of 640 cubic feet of air per i.h.p. per hour, a reduction of 850—640—210 cu. ft. of free air per i.h.p. per hour due to pre-heating. Thus 210-850, a saving of 24.7 per cent. is effected in the quantity of air used.

This saving was effected by the burning of 9.3 lbs. of coke per hour, or of 9.3-26.7 348 lbs. per h.p. per hour.

These results may be stated otherwise as follows:

To produce 100 h.p. with cold air, 85,000 cu. ft. of air were required in this engine; when pre-heated to 287 F., the horse-power yielded was 85,000—640—133 h.p., and as this heating was effected by the burning of $\frac{9.3 \times 133}{27}$ 47 lbs. of coke per hour; the additional 33 h.p. were obtained by an expenditure of 47 lbs. of coke per hour, or at the rate of $\frac{47}{33}$ 1.42 lbs. of coke per hour additional.

If we assume that this gas coke had ¾ of the calorific value of good coal, it is seen that we obtained an additional horse-power for every (1.42 x ¾) 1 lb. of coal burnt in the heater.

As an ordinary steam engine and boiler of this size would require from 4 to 8 lbs. of good coal per h.p. per hour, it is seen what a very economical mode of using the heat this is. Heat is used 4 to 8 times as efficiently in a compressed air pre-heater as it is in a steam engine and boiler.

With regard to the results of this trial it ought to be remarked that a large radiation loss per lb. of air used was taking place, both on account of the undue size of the heater and on account of its distance from the engine. Much more favorable results can be, and in fact have been obtained, when the size of the engine and heater are properly proportioned.

Professors Riedler and Guttermuth have obtained an additional horse-power in air motors for every ¾-lb. of coal burnt to heat the air. This is an economy far surpassing that of any prime motor in existence.

In large plants with first-class air motors, where double or triple pre-heating might be resorted to, a better result than even this can easily be obtained.

In a large transmission plant consisting of a Taylor Air Compressor, a five-mile pipe line, air engines and electric generators, with coke pre-heating stoves, the full or gross power of the water fall can be obtained at the terminals of the dynamo, at a comparatively insignificant cost for fuel.

No other system of energy transmission can compare with this for economy of first cost and maintenace.

3. Tests were made of the economy to be obtained by heating the air by mixing it with steam from a boiler before allowing it to do work in the engine.

The results are of the highest scientific interest, and show the adaptability of compressed air to almost any condition of employment. As regards economy, this method is, however, inferior to that of dry heating. By mixing from 10 to 13 lbs. of steam per h.p. with the air, the quantity of air required was reduced from 850 cu. ft. to 300 to 500 cu. ft. per i.h.p. per hour. Thus the air required for 100 h.p. engine running with cold air would be sufficient to operate an engine of 85,000—400—210 h.p. if mixed with 12½ x 100—1,250 lbs. of steam per hour. This can be supplied by about 140 lbs. of coal per hour; so that 110 h.p. additional were obtained by the burning of 140 lbs. of coal or 140—110—1.3 lbs. of coal per i.h.p. per hour additional.

Such a method of heating, economical as it may appear, would, however, be unsuitable except for powers of over 50 h.p. unless waste steam is available from a boiler plant at times of low demand.

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Correspondence is invited upon all topics legitimately coming within the scope of this journal

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Peculiar Method of Appointing a Chief Engineer.

The city council of Toronto recently appointed Messrs. George C. Robb and A. M. Wickens to examine and report upon applications for the position of chief engineer of the new municipal buildings. It is surprising to learn on enquiry that applications for this important position were not publicly invited. It is further learned that no particulars were placed at the disposal of the experts regarding the duties of the position, and no one about the building appears to have any idea of what these duties will be. Under these circumstances, the experts have a somewhat difficult task to perform. They will be obliged to go over the building and estimate for themselves what duties should appertain to the position of chief engineer, and in the light of the information thus gained, examine and report upon the applications which are understood to be in the hands of the city officials. The number of these applications is reported to be large, but in what way they were received is not publicly known. The council's method of selecting a man for this important position is unsatisfactory. Applications should have been advertised for, and a date fixed for their reception. The duties of the position should have been clearly specified by the city engineer or some other competent person. The method of procedure adopted, leaves room for the suspicion that probably there exists some favored applicant, to whom the position has been promised, and that the engaging of experts to report upon the applications is simply a device to give the appearance of fairness to the appointment.

A Word to Lighting Companies.

WE have reason to believe that some of the owners and managers of electric lighting companies have not read with sufficient care the provisions of the Conmee Bill passed at the last session of the Ontario Legislature, defining the conditions on which municipalities may engage in the electric light business where a private company is established. One of the most important clauses in the Bill to electric lighting companies is Sub-section 26, which reads as follows: In case there is any gas or electric light company supplying gas, electric energy or light or water company supplying water in any municipality the council may, by by-law, fix a price and terms to offer for the supply by contract by such gas or electric light company of gas or electric energy or light for street lighting and other public uses, or for the supply by contract by such water company of water for street hydrants and other public uses for a term of not less than five years and not more than ten years, and after thirty days have elapsed after notice of such price and terms has been communicated to the company without the company's having accepted the same, the council may, under the provisions of this Act, as to arbitrations, name and give notice of an arbitrator to determine the price and terms of the contract for such supply of gas or electric light as aforesaid, and in case the company and the municipality do not agree, the said price and terms shall be dedetermined by arbitration under this Act." The important point in this clause to lighting companies is, that where an offer of purchase is made to a company by a municipality, and declined by the company, the company must, regardless of any action of the municipality, appoint, within thirty days after such offer of purchase has been made, an arbitrator to act on its behalf. If the company fail to thus appoint an arbitrator within thirty days after the offer of purchase, the municipality would seem to have the right to refuse to enter into arbitration, and may proceed to purchase and install a lighting plant. There are other points of the Bill which are scarcely less important, therefore lighting companies should make themselves thoroughly acquainted with every detail and understand clearly the interpretation of every provision.

The Telephone Field.

There is evidence to justify the belief that the telephone will become much more generally used in the near future than it is to-day. In the large cities and towns it has been adopted very largely for business purposes, and even the farmer has to some extent recognized the advantages of telephonic communication. It is in this latter direction that we look tor one of the most promising fields tor the extension of the telephone business in the future. Particularly in the harvesting season does the farmer realize the advantages of having telephone connection with an adjacent village or town, by means of which he can order necessary repairs and supplies. The state of Ohio in the United States, is noted for its rural telephone system. Hundreds of farmers have telephones in their homes, and in addition to business advantage, their families are afforded some of the social privileges that are frequently lacking on the farm. The use of the house telephone in this country is, to our minds, restricted to a much greater extent than it should be or will be in the near future. There is also likely to be a considerable increase in the number of private exchanges. These effect a vast saving of time, and permit the heads of departments to communicate with all parts of the establishment without leaving their offices. In the United States the expiration of the Bell Telephone patents, and the competition thus permitted, has resulted in the development of the telephone business to a remarkable extent.

Electric Power Distribution and the Small Consumers.

In an interesting article under the above title, in the Engineering Magazine for November Dr. Louis Bell discusses the advantages afforded by electricity to small consumers of power. He also points out to electrical companies that the supply of current for power in small units can be made profitable where a sufficient number of such consumers can be obtained. He estimates that few consumers of steam power of 50 horse power or under can obtain their power for less than 5 cents per horse power hour actually employed, and that where an ample load can be obtained large generating stations can put electrical energy upon their circuits at a total cost somewhat under one cent per horse power hour, thus enabling them to supply the consumer at a large reduction. The possibilities of electrical distribution of current for light and power from a central water power generating station are likewise considered. As an example of a successful enterprise of this character the writer calls attention to what has been done by the Compagnie Electrique de la Loire at St. Etienne, France, where, by means of the three phase system, power is supplied in small units to 2,500 ribbon looms which formerly were operated by hand, but found themselves unable to compete with the large manufactories in the cities operated by power. A quarter horse power motor serves for each loom, so that the total load connected amounts to about 1,400 horse power. The charge for each quarter horse power motor is 10 francs per month. The company also operate 100 horse power in miscellaneous motors and 8,000 incandescent lamps, and are said to have made a success of their enterprise. Dr. Bell points out further that the utilization of electricity in the manner described would be the means of restoring prosperity to many of the towns throughout the country where manufactories were formerly located, but which are suffering from centralization of the manufacturing business in cities, where advantages in the way of cheaper power and improved transportation facilities are available. So far as the latter advantage is concerned, it is shown that the same system which supplies light and power might also be used to operate electric railways for passenger and freight purposes, which would tend to equalize transportation advantages.

Operation of Electric Street Railways.

The system of electrical distribution adopted by the Metropolitan Railway Company represents a new practice in the operation of street railways in Canada. This road is, we believe, the first in this country to employ both direct and alternating currents for the propulsion of cars, but the system will undoubtedly gradually grow in favor in connection with the operation of long distance lines. It has only recently come into use in the United States, the Chicago & Milwaukee Electric Railway being one of the first to be so operated. This road is divided into sections, each section, except the one contiguous to the power house, being operated from a substation containing an equipment of transformers and rotary converters. This is the method adopted by the Metropolitan Railway Company, but a further step in advance has been taken, inasmuch as both direct and alternating current is generated by the same machine. The direct current passes direct from the generator to the line, and is employed to operate that portion of the road adjacent to the power house. The alternating current, generated at low pressure, is stepped-up by means of transformers to a high voltage and transmitted to a sub-station sixteen miles distant, where it passes through transformers and converters and goes to the line at low pressure direct current for operating that portion of the road remote from the power house. It is admitted that this system of electrical generation and distribution has many advantages, as, for instance, making at once available direct current for use in the three-wire system without passing through auxiliary machines. The alternating current, however, in order to be suitable for service at a distance, must be raised in pressure by means of transformers. This system is, therefore, open to the objection—perhaps overbalanced by its advantages—that it necessitates an expensive station equipment because of the rotary converters and transformers required for changing the pressure and kind of current. There is reason to expect that this object will eventually be overcome in some way, probably by the introduction of machines capable of generating both direct and alternating current at the desired pressure, or, in other words, by high voltage alternating and low voltage direct current generators. This would obviate the necessity for auxiliary apparatus in the generating station. The certainty of the rapid extension of interurban electric railways in this country makes of paramount importance the question of the most practicable and economical system of operation.

Tooke Bros., Montreal, have bought three more 8 h.p. motors from the Canadian General Electric Co., for use in their factory.

MONTREAL

Branch Office of the CANADIAN ELECTRICAL NEWS,
New York Life Building,

MONTREAL, Dec. 2nd, 1899.

IT need not surprise anybody if it is found shortly that a prominent Canadian electrical company will not only do the lighting but the wiring for the Canadian building of the Paris Exposition. It is said that if they are the successful tenderers they will send their own wiremen and material from this side of the water, also generators, and follow our usual practice. National Board rules, it is said, are to govern.

It may interest some of our readers to know that the steamship Arawa, being used by the British government as a troopship, and which is reported as being delayed owing to a break-down in her electrical machinery, belongs to the Elder Dempster Co., and lately ran to Montreal. Her electric machinery referred to is the lighting plant, which is in duplicate, and consists of alternators of the Ferranti type delivering current to the lighting circuits at a potential of 110 volts.

According to a contemporary all fires not put down to "electric lights" are put to "Israelites."

The apartment building being built on Dominion square, Montreal, for Mr. M. S. Foley, is to be lighted throughout by electricity, the tenderer for the wiring being Messrs. Mount Bros. The architects are Messrs. Saxe & Archibald, Montreal. Iron armoured conduit is specified.

In the person of Mr. R. Whyte, the Lachine Rapids Company have a rarity—not alone for the fact that everybody has a good word to say of him, and he has a good word to say for them all in the trade, but because as secretary-treasurer of the company he has also a fair practical knowledge of the electric lighting industry. Mr. Whyte was first connected with Mr. Lawson, who, we believe, first represented the Brush interests, and later was with the Edison Company. Later still he was employed by the Canadian General Electric Company and the Royal Electric Company successively, to assume finally his present duties, where he carries the best wishes of not only his old practical friends, but also of the new Lachine Rapids Company's customers.

The Montreal Wire & Cable Company expect shortly to be in operation. They are now awaiting alternating motors ordered, by which they intend to operate their various machines. It is understood that it is not the intention to direct-connect, but to use a motor on each flat or section. The building chosen is that formerly occupied by E. A. Small & Co., wholesale clothiers, at the foot of Beaver Hall Hill. There is ample floor space and each flat has sufficient windows to constitute a well lighted factory. Incandescent light will be used for artificial illumination, the current being supplied by one of the lighting companies in the city. Alex. Barrie, manufacturer of rubber covered wires, together with his plant (which will be augmented), has been absorbed by the new concern, and Mr. Barrie will attend to the practical work. The management will be in the hands of Mr. Sise, jr., who was formerly with the Western Electric Co., of New York.

The recent disclosures in the daily press of crooked dealings of officials of several departments of the city service reminds me of a conversation had recently with a gentleman representing an Ontario company who do business in the city of Montreal, and who have found it difficult to conduct business here owing to their refusal to pay commissions to certain individuals connected with the city service. I heard of an instance the other day where the inventor of a non-freezing valve stated that after having found it impossible to introduce the invention in this city, he at last succeeded in doing so by following the advice of a friend who told him that a certain amount of money placed with a certain individual would remove the obstacles out of his way. The money was placed accordingly, and the obstacles immediately disappeared. An amusing story was also told me which serves to define the standard of business probity existing in this locality. A director of the Montreal Park & Island Railway who was also interested in the toll-gate system, was asked by a gentleman, while passing through the toll-gate one day, what check was kept upon the toll-gate keeper to insure his making proper returns of the money paid to him. The director's reply was: "Oh, we do not keep any check on him; he's an honest man; he would not steal more than a dollar or two per week."

"What we have we will hold," said the person who held the electrodes of the induction coil!

Mr. John Forman has purchased the entire stock in hand of the Canadian Bryant Electric Co., who lately decided to close their Canadian factory.

Mr. C. E. Shedrick, electrical instrument manufacturer, of Sherbrooke, Que., paid a visit to his trade friends in Montreal last week, and, I understand, secured some orders.

Mr. A. F. Gault is the owner of the flat apartments being built on Milton street, and named "The Marlboro." They are to be wired for electric light thoughout. Messrs. Taylor & Gordon are the architects.

Messrs. Collyer & Brock, of this city, have secured a contract to re-arrange and add to the incandescent light equipment of the Montreal Rolling Mills Company, also to add to their D.C. series arc equipment in the yard.

The Lachine Rapids people are looking forward with interest to the approach of winter, which they claim will this year have no terrors for them. The new steam power reserve is installed for emergencies and the engines have been tested.

The Richelieu and Ontario Navigation Company contemplate building a large hotel at Murray Bay, Que., during the winter. An electrical plant will probably be installed for lighting. Tenders for the wiring have already been called by Messrs. Maxwell & Shattuck, architects.

Look out for the next legal electric fight at Quebec. The poles of the Jacques Cartier Company are going in pretty near to those of the Montmorency Electric Co., and a struggle in the courts similar to one recently held in Montreal may be expected when the lines get strung and into operation.

The Royal Electric Company have a "good thing" in their new Stanley meter, "magnetic flotation" type. It will have to be a remarkably high efficiency lamp that this meter will not only start on, but keep an accurate note of the consumption, and that lamp need not be a 16 c.p. one either, by any means.

Mr. R. A. Ross, electrical engineer for the Canadian Pacific Railway Company, is back again in Montreal. He has been for a time in China, and came back via Burmah, making a tour of the world. Mr. Ross does not speak in very glowing terms of some of the electrical construction work he witnessed abroad.

The block of four houses, with grey limestone fronts, lately built on Dorchester street west, corner of Hallowell street, in the suburb of Westmount, are the property of Mr. D. J. Darling. The architect for same was Mr. A. J. Cooke, and the electric light wiring and bells was done by the Montreal Electric Company.

Mr. C. J. McCuaig, of McCuaig, Rykert & Co., mining brokers, Montreal, is building a couple of handsome red stone houses on Sherbrooke street, adjoining the property of Mr. Jas. Linton. Messrs. McVicar & Heriot are the architects. The wiring for electric light and annunciators fell to the Montreal Electric Company.

It is currently rumored that a new lamp factory (incandescent) will shortly be operated in Montreal or vicinity. It is said that the Bryan Marsh Co. (who conduct a similar industry in the United States) will manufacture their lamps here, in company with three or four local men of capital connected with the electrical business. The output is placed at 1,000 lamps per day.

The Montreal Street Railway Company already have the sympathy of the electrical trade in their gallant fight to try and resist what seems an unjust mode of taxation; they might also have the sympathy of the general public if they would provide increased car accommodation for business men at business hours. Some say lack of cars is the trouble, but one electrically versed says it is lack of copper. It is a well known fact that Quebec, with fewer cars, etc., is wired heavier than Montreal, so it would appear as if the latter view was not far out.

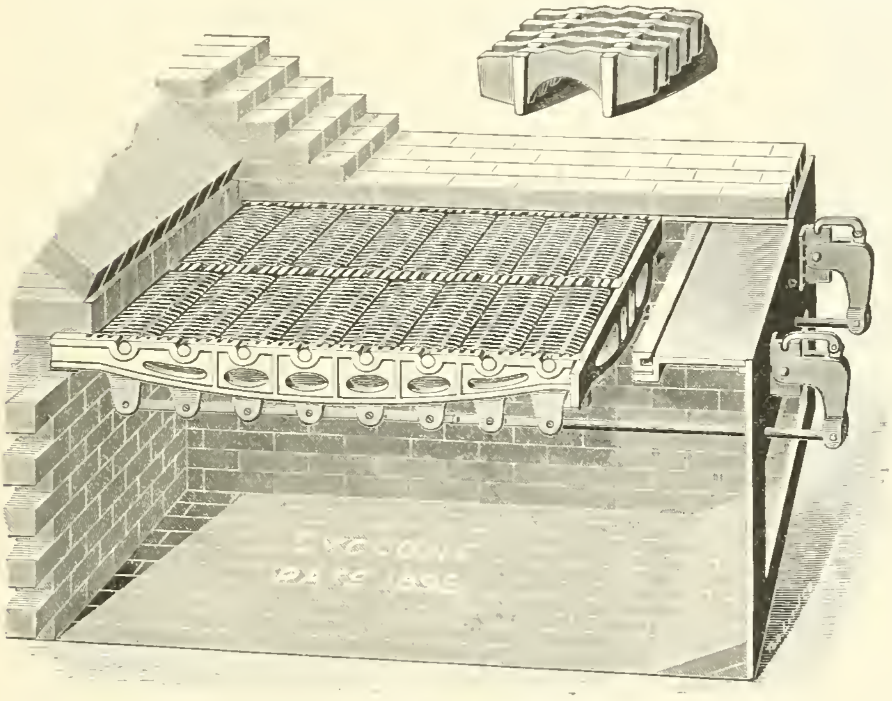
About a year ago a prominent Notre Dame street furrier had an acetylene plant and fixings installed, and threw out his electric light. Some months later the Underwriters' inspector visited him and caused some expensive changes to be made. Now he has electric light re-installed, and the plant for light which ruined the eyes of his operatives and made a nasty odor in the establisment is for sale.

A gentleman who resides out of town during the summer months entered an electrical store the other day to get a figure for a couple of telephones and cable sufficient to connect them, one each side of a small river, virtually a canal. The gentleman wished to call his man with his boat to row him over to his house on arrival of the train. Naturally, the job was expensive, as the cable had to go under water, and the pseudo-customer was aghast. He was then asked: "What's the matter with a tin horn?" The very simplicity of the idea did not seem to have struck him; needless to say it was adopted, and no "grounds" or "short-circuits" have been reported.

THE CYCLONE GRATE BAR.

Presuming the majorty of our readers to be interested in methods of economizing fuel, we present herewith some particulars of the Cyclone grate bar, one of the most improved devices for this purpose. In the invention and manufacture of this device, the fact has been kept in view that an enormous waste of fuel is constantly taking place by reason of the escaping of the carbonic oxides of the fuel. This is the result of inperfect combustion caused by imperfect draught, combustion chambers and bridge walls in boilers, together with imperfectly managed fires. While the inventor and manufacturers of the Cyclone grate bar do not claim it to be a smoke consumer, they do claim to reduce by from 40 to 65 per cent. the amount of carbonic oxides escaping through the chimney, which is a proof of its value as a fuel economizer.

It is claimed for this grate that it embodies the three most essential qualities, namely, durability, simplicity, and economy of fuel. An examination of the accompanying illustration will, it is believed, show these claims to be well founded. The air is passed up and through the grate without a break in the current. There are no complicated parts to obstruct the draft and get out of order, while the sifting movement alone with the downward and backward movements cuts the ash evenly and cleanly from the bottom of the fire over the entire surface of the grate.


The Cyclone Grate Bar.

It is not claimed for this grate that it will grind up clinkers and separate them from the unconsumed coal without losing any of the latter material, but that it is so constructed as to prevent the formation of clinkers, by admitting the necessary amount of air through the grate to insure perfect combustion, and cause the heat to pass out of the fire box as fast as it accumulates, instead of allowing it to remain and melt the coal and form a melted clinker that no grate could break. It has been found in practice that the weight of air required to support combustion is much larger than that theoretically required in order to effect complete combustion. Complete combustion can be obtained with a supply of air not less than 50 per cent. in excess of the quantity necessary for theoretical combustion with natural draft, but it is usual to provide double the quantity of air theoretically required.

This grate is especially adapted to burn cheap fuel, soft and hard coal, screenings, etc., and for use in marine boilers. Among the claims made for it by the manufacturers are the following:

It is the best draft grate in the market ; has no rockers and no complicated parts to get out of order underneath the bar or obstruct the draft ; the rolling and lifting movement when shaken keeps the air space open and causes no friction on the draft passing through the bar ; has ninety per cent. under draft ; the frame locks together without bolts, and is easily placed under boiler ; will not lock in frame, will not bind in frame ; always shakes freely ; space in ash-pit same as in ordinary bar, which is four inches ; is a perfect bar for all internal fire boilers, no part is in the way to prevent the fireman cleaning out the ashes ; the air s passed through and over top of fram e—keeps frame cool and prevents warping ; all parts of the bar and frame are trussed and bridged ; will burn the cheapest fuel with the best results ; will evaporate more water per pound of coal than any other device ; is level at all times when locked ; no bars stick up in fire and burn off ; will not break boiler front when shaking.

This important fuel-saving device is manufactured by the Cyclone Grate Bar Company, 10 King St. West, Toronto, who will be pleased to furnish, on request, to any of our readers further information with regard to it. The attention of readers is also directed to the company's advertisement in this issue, and to the testimonial of the Canadian Pacific Railway Co. appearing therein.

PERSONAL.

Mr. J. A. Hicks, graduate of the Canadian General Electric Company's works at Peterboro, Ont., has recently been appointed inspector for the Royal Electric Company in Montreal.

Mr. J. Eastland, who for six years has held the position of foreman of the London Electric Company, of London, Ont., has removed to Detroit, where he has secured a lucrative position with the Bell Telephone Company of that city.

Mr. Granville C. Cunningham, formerly manager of the Montreal Street Railway, but who later was associated with the street railway at Birmingham, Eng., has accepted a position as manager of the London Central Electric Tramway Co., of London, Eng.

Mr. James Wallace, road-master of the Toronto Railway, has been appointed to a responsible position in connection with the management of the Winnipeg Street Railway, and left for that city a fortnight ago. Mr. Wallace had been in the service of the Toronto Railway Co. for many years.

Mr. A. F. Nash, of Windsor, Ont., has been appointed inspector of electric light and gas for the London district, as successor to the late Mr. Williams. Mr. Nash was for a number of years manager of the Windsor Gas Co., and also owned the electric light plant before it was purchased by the city.

By invitation, Mr. Frederic A. Hamilton, electrical engineer, Halifax, N. S., paid a visit to Mr. Marconi on board the steamship La Grand Duchesse on the occasion of the International yacht race at New York. Mr. Marconi very kindly transmitted a telegram for Mr. Hamilton from that vessel when off Sandy Hook to Sir Sanford Fleming, as follows :—"Off Sandy Hook light-ship —this is a wireless message." We regret to learn that Mr. Hamilton has recently been incapaciated by illness from attending his usual duties, but is now on the way to recovery.

Among recent visitors, the Electrical News had the pleasure of a call from Mr. Thos. H. McCauley, of Port Arthur. Mr. McCauley is local manager at Port Arthur for the Bell Telephone Co., and superintendent of the Port Arthur Electric Street Railway and Light Systems, which are the property of the municipality. Mr. McCauley spent a couple of weeks in the east, during which he visited a number of the most interesting electrical installations, including that of the Cataract Power Co., the Chambly Mfg., Co., and the Lachine Rapids Hydraulic & Land Co. The municipal authorities of Port Arthur are at present considering the question of operating their plant by water instead of steam. The belief is that by making the change a saving of several hundred dollars per month could be effected in the fuel account.

The Massey-Harris Company, of Toronto, have placed their order with the Canadian General Electric Company for a complete switchboard outfit for their new plant.

Incorporation has been granted to the Renfrew Electric Co., Limited, of Renfrew, Ont., to carry on the business of supplying electric light and power. The directors are A. A. Wright, Chas. Wright, Howard Wright, A. H. Hough and William Ringseben.

TELEGRAPH and TELEPHONE

C. P. R. TELEGRAPH APPOINTMENTS.

A SUCCESSOR to Mr. Chas. Hosmer, manager of the C. P. R. Telegraphs, has been named in the person of Mr. James Kent, whose portrait appears herewith. Mr. Kent entered the service of the Montreal Telegraph Co. as messenger shortly after leaving school in 1868. He soon became an operator, and after working at such for five years was appointed night chief, and subsequently day wire chief. The latter position he held until 1886, when he resigned to accept the position of chief operator of the C. P. R. Telegraphs at Montreal. In 1890 he was promoted to the superintendency of the Eastern division of the same system, which position he held until receiving his present appointment.

Mr. Kent is succeeded as superintendent of the Eastern division by Mr. W. J. Camp, with headquarters at Montreal, while Mr. A. W. Barber, local manager at Toronto, becomes superintendent of the Ontario division. Mr. C. S. Jenkins, superintendent at Winnipeg, is given the superintendency of lines west of Fort William, with head office in Winnipeg. All the appointments are well deserved.

MR. JAMES KENT.

MARCONI'S WIRELESS TELEGRAPHY.*

BY W. B. BRADFIELD.

As is, of course, well known, the Marconi system is worked by means of Hertzian waves, so called after the late eminent German professor, Hienrich Hertz, who first experimentally proved their existence 30 years or so after Clerk Maxwell had mathematically predicted them.

At his New Jersey station Mr. Marconi employs the following apparatus to generate and collect these waves: The first thing that is apparent to the observer is a tall mast, 150 feet high, from the top of which is suspended a wire—it is actually an ordinary insulated copper wire, such as is used for electric-lighting purposes—which passes through a window of the operating room and is joined up inside with the apparatus. There is nothing strange in the appearance of the mast itself, and no effort is made to clothe this part of the apparatus with mystery. With regard to apparatus within the room, simplicity is the most amazing part of it. The whole apparatus is fixed on a small table about four feet long and two feet wide, and the battery for supplying the power is packed underneath it.

This battery consists of 98 dry cells, which are connected up 14 in series, and seven in derivation, and is joined up in parallel with eight accumulator cells to give a steady current of six amperes. The actual generator of the waves is an ordinary inductor or Rhumkorff coil, such as is used for the production of X-rays, and is capable of giving a 10-inch spark. Each end of the secondary winding of this coil is fitted with a sparkling rod, to which is attached a brass ball 1½ inches in diameter.

To one of these balls is connected the vertical wire; the other is joined to earth. With the single addition of a Morse key in the primary circuit the transmitting apparatus is complete.

Consider for a moment what happens when this key is depressed. The immediate and apparent result is a loud, crackling spark discharged between the two brass balls which are adjusted to be about two contimeters apart. The more important result is that the vertical wire at the moment the spark passes emits waves which go out into space in all directions, and continue to do so as long as the key is depressed. It is quite easy to understand, therefore, that by depressing the key for a short or a long period short and long series of waves or oscillations are emitted, and the Morse alphabet, which is used in ordinary telegraphy, may be employed.

The only thing that remains is to get something that will pick up and indicate the presence of these oscillations.

The apparatus which Marconi employs to do this is what is commonly known as a "coherer," a name which is due to Professor Oliver Lodge, of Liverpool. An Italian, named Calzecchi, was the first to discover the sensibility of coherers and filings tubes to Hertz waves. He found that metallic filings in a loose state of contract offered an appreciable resistance to the passage of a current. He found, also, however, that on exposing these filings to the action of Hertzian waves the resistance fell enormously, but that on shaking them up the resistance was increased again to its original value. Marconi's coherer works on on the same principle, but is vastly more sensitive and reliable than those used by Calzecchi, Branly and others.

It consists of a small glass tube about two inches long, in which two small silver plugs a quarter of an inch long are tightly fitted and separated from each other by about one-thirtieth of an inch, the gap between them being partially filled with a mixture of nickel and silver filings, these metals having been found to be the most sensitive and reliable after a long series of experiments. The coherer is exhausted to a vacuum of four millimeters.

So much for the coherer. The rest of the receiving apparatus is perfectly easy to understand. In circuit with the coherer is a single dry cell and a telegraphic relay of the ordinary type. This relay is used to close the circuit of a local battery, which works a Morse writing instrument, and also an electric bell hammer, which strikes the coherer a smart tap to restore it to its normal high resistance after it has received an impulse from the distant transmitter.

To protect the coherer from the too powerful effects of the local transmitter the whole receiver is enclosed in a metallic box.

To receive a message all that is now necessary is to connect the vertical line either directly or through a small induction coil to one end of the coherer, the other end of it being connected to earth.

Such is the Marconi apparatus in use at the Herald's New Jersey land staton, and it is in exact duplicate aboard the steamer Ponce. She has been specially rigged with a new topmast to give the same height of wire as that at the land station, and the instruments are installed in the chart house.

The distance that will have to be bridged will probably not exceed 35 miles; the apparatus employed would, however, be capable of sending and receiving messages at a distance of nearly 80 miles.

The chief factor in determining the distance possible is the height of the vertical wire. Mr. Marconi finds that by doubling the height the distance becomes quadrupled. That is, assuming 20 feet will give one mile, 40 feet will give 4 miles, 80 feet 16 miles, and so on. There are, of course, other factors, such as the sensitiveness of the coherer and the adjustment of the apparatus generally, but apparently they are not so marked in their effects.

Why this vertical wire is necessary for long distances is not very certain. It has been suggested that the earths curvature may have something to do with it. Compare this, however, with Mr. Marconi's results in the English naval manoeuvres this summer, when with 150 feet of wire at each end he succeeded in telegraphing 75 miles. To do this the waves must have passed through a "hill" of water 35 miles long and 700 feet high. More probably, the vertical wire is necessary because its use lengthens the waves and propogates them in a plane vertical to the surface of the earth, and they are, therefore, less likely to be absorbed by it. The fact that the waves are lengthened, of course, causes them to be more penetrative and capable of effecting a receiver at a greater distance

Of the working of a wireless-telegraph station there is not much to say, as it is essentially the same as that of any other telegraph office. At present the speed of transmission is rather less; it does not ordinarily exceed about 15 words a minute, but this will, of course, increase with time. A call is indicated by a bell which is switched off during the reception of a message. As before stated, the telegrams are printed in dots and dashes on an ordinary Morse inker, the operator having merely to read them from the tape.

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* From the New York Herald. Mr. Bradfield is Mr. Marconi's assistant.

The key used is of a slightly different form from the usual Morse key, the back contact being used to connect the vertical wire to the receiver, so that no changing over from the transmitter to the receiver is necessary after sending a message.

[This article was referred to editorially and intended to have been published in our November issue, but was inadvertently omitted.—THE EDITOR.]

AUTOMATIC TELEPHONE EXCHANGES.

AN English contemporary gives an interesting description of the automatic telephone system controlled by the Direct Telephone Exchange System of London. In the case of a small exchange of one hundred subscribers, such as would be used for a small town or in a large office or hotel, the subscribers would be numbered from 101 to 199. The instrument (Fig. 1) which each subscriber has is very similar to an ordinary telephone set. In front there is a rotating disc D provided with holes numbered 1, 2, ... 0. Suppose that a subscriber wants to make connection with No. 139. He inserts the tip of his finger in 1 and pulls the dial round until his finger reaches the stop S; he then lets it go, and it automatically rotates back to its original position. He next does the same operation at 3 and then at 9. This makes connection between his telephone and that of No. 139. He now rings his magneto bell in the ordinary way, and if his own bell G rings at the same time, he knows that No. 139 is not engaged; if, on the other hand, his own bell does not ring, he knows that it is engaged. In the former case he takes his telephone off the hook H and talks into the transmitter T. Whilst he is talking with No. 139 it is impossible for any one else to ring either of them up. When the conversation is finished the mere act of hanging up the telephone on H moves their switches at the exchange back to their normal positions and so leaves them both ready to be called up by any other subscriber.

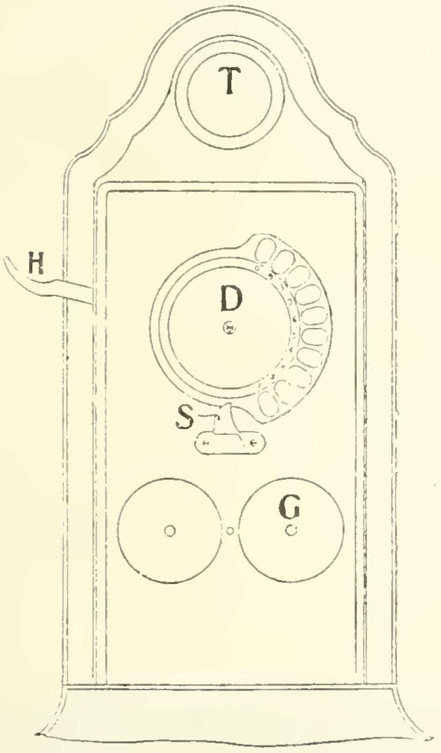


FIG. 1.

It will be seen that all the exchange work is done by the subscriber himself, the time required to do it being only from three to five seconds. Again, as they are not at the mercy of the exchange girl, the conversation is absolutely secret, and cannot be interrupted except at the option of those talking.

From each subscriber's telephone two wires go to the central station, and the electric impulses that are sent along them operate the apparatus at the exchange. The mechanism of the dial on each telephone is not unlike that of the apparatus used in messenger call systems. Turning round this dial winds up a spring, which, as it runs down, operates a toothed wheel, and so sends a definite number of electric impulses along the line. The tension of the spring admits of easy adjustment, and there is a governing arrangement to regulate the speed. At the exchange there in an elaborate switch for each subscriber, which he alone can operate by his dial, and only when this switch is in its normal position can he be called up. Although highly elaborate, the design of this switch is sound, and occasional attention from a mechanician would be sufficient to keep it in thorough working order. Part of it consists of a concave surface (fig. 2) formed of plaster of Paris in which is embedded a number of contact pins corresponding to the number of subscribers, each of which is in connection with a subscriber's wire. In the figure, part of one of the hundred switches in a hundred exchange is shown. It will be seen that there are ten rows, and ten contact points in each row. The arrangement of the contact pins in the insulating material is also shown. In the axis of the cylinder of which this surface is a portion there is a rotating axle carrying a radial contact peice or wiper, which can be made to have contact with any of the contact pins. The first current impulse sent over the line brings the wiper into position, one tooth behind the first pin. The second series of impulses raises the rotating axle so that the wiper comes opposite the required tens line. In the case supposed it would be raised so that it was opposite third row. The third series of impulses rotates the shaft bodily, so that the wiper comes in connection with the ninth pin on the third row. The subscriber is now through to 139. The fact that these two are in talking connection does not interfere with the other subscribers, except in so far that neither of them can be called up by any one until they have finished their conversation. It would be quite possible for ten or twenty different calls to be accomplished at the same time, as the action of each switch is practically independent, and the accumulators at the central station can supply a large current.

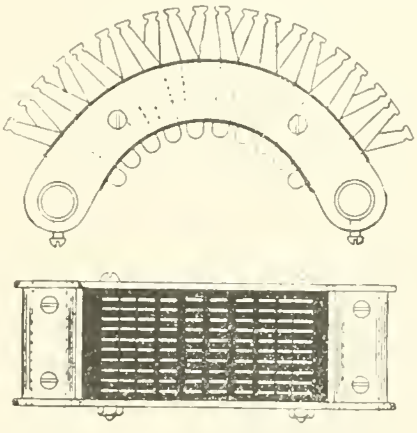


FIG. 2.

The automatic exchanges are built in three sizes: the first includes the 100 to 400 system in which only a single switch is used for each subscriber. The second and third, which are for 1,000 and 10,000 subscribers respectively, need two switches per subscriber. In the larger exchanges the "bridging system" is used. In this the electro-magnets do not form part of the talking circuits, and so they can be made of relatively high resistance and consequently can be operated by a smaller current. Inh the ordinary exchange each subscriber takes about 0·5 of an ampere to operate his switch, but when the bridging system is used 0·2 of an ampere is ample. To give an idea of the size of each switch, it may be mentioned that in a 200 exchange each switch occupies a lineal space of 12 in. by 4 in. and projects 6 in. from its base. It is stated that a room 40 by 45ft. in floor space is large enough for a 5,000 exchange. It is also stated that one man can look after 1,000 instruments. When it is remembered that in an ordinary manual exchange one operator can only attend from 50 to 100 subscribers, there is an obvious economy in labor.

SHORT CIRCUITS.

The Citizens Telephone & Electric Company, of Rat Portage, Ont., has installed a new telephone switchboard.

The residents of Danford Lake, Que., purpose forming a joint stock company to build a telephone line from Danford to Kazubazua Station.

Doctors Paul and Eckhert, of Sebringvllle, Ont., have obtained right of way to erect a telephone line from that place to Avonton and Carlingford.

The Pennfield & St. George Telephone Company are building a telephone line from St. George to Black's Harbor, Beaver Harbor and Pennfield, N.B.

Incorporation has just been granted to the Carman Telephone Exchange Co., composed of merchants of Carman, Man. The company purpose building a telephone system.

The Dominion Government are believed to have decided to adopt the wireless telegraphy system between the Labrador coast and Belle Isle, where the steamer Scotsman was wrecked.

Messrs. James Kent, superintendent, and W. J. Camp, electrician C. P. R. Telegraphs, returned to Montreal last month, after having fitted up the new telegraph office at Vancouver.

Mr. D. Budge, of Halifax, has been appointed general superintendent on this side of the Atlantic of the Halifax & Bermuda Cable Co. and the Direct West India Cable Co. His headquarters will be in Halifax.

The North-Western Telephone Exchange Co., which controls the long distance lines in the North-West, has given notice that the company has decided to extend its system to include the line of the Great Northern road to St. Vincent.

The British Columbia Telephone Co. intend to connect Victoria and Vancouver, a distance of 26 miles, by a telephone cable. This cable will be equal in length to the longest submarine cable in the world, that between England and France, crossing the English channel.

ELECTRIC RAILWAY DEPARTMENT.

THE METROPOLITAN ELECTRIC RAILWAY.

For some years previous to 1800 the Metropolitan Railway Company operated a horse car line on Yonge street from the C.P.R. tracks at the northern city limits of Toronto to Glen Grove, a distance of two and three-quarter miles. In that year electricity was substituted for animal power for the propulsion of the cars, the power house being situated about midway between the two terminals of the road, and current being furnished by a Thomson-Houston dynamo. Gradually extensions were made northwards, and in 1897 the line had reached Richmond Hill, a distance of fourteen miles. Encouraged, perhaps, by the success of this extension, the company concluded to undertake further extensions which had been under consideration, and during the past summer the line was completed and put in operation as far as Newmarket, a distance of about thirty miles. The route for almost the entire distance follows the public highway of Yonge street, and passes through a chain of suburban villages and country residence districts, as well as the town of Aurora. In order to obviate possible objections by any municipality, the company secured the passing of an act whereby the whole of Yonge street north of the C.P.R. tracks was placed in the control of the county of York. It is understood to be the intention of the company to eventually reach Lake Simcoe.

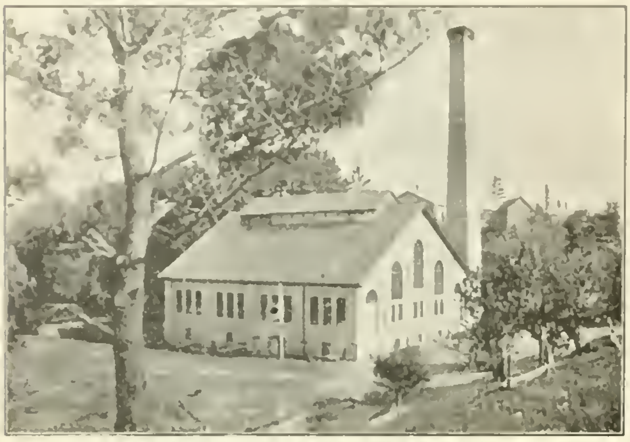


Fig. 1.—Power House.

The system of the Metropolitan Railway Company presents many interesting features. One of these is the unusually heavy grades encountered; another the method of generating and distributing the current, which we believe represents an entirely new practice in street railway operation in Canada.

THE POWER HOUSE.

The extensions to the road necessitated the erection of a new power house, for which Nature had provided an ideal site. About twenty miles from the southern terminus of the road, Yonge street converges slightly to the west for the purpose of rendering unnecessary the crossing of a valley. In this valley, and occupying almost the total area, is situated Bond's Lake, which covers an area of forty-eight acres and has a depth at some points of over 100 feet, and around which the land rises to a considerable height, making a very picturesque view. It is in this valley, and bordering on the lake, that the new power house is located, the top of the building being but a few feet above the level of the land. The advantage of this location is that an unlimited supply of water is always obtainable for condensing purposes without the necessity of pumping.

The power house, shown in Fig. 1, was designed by Messrs. Gordon & Helliwell, architects, of Toronto, Mr. John Aldrich being the contractor for labor and the Metropolitan Company supplying all material. It is an imposing white brick structure, with stone foundation and iron and slate roof. The floor is of concrete supported by steel girders, and the window frames and sashes are of cast iron, the object of the company being to erect an entirely fireproof building. Owing to the advantageous location, very little excavating was necessary. The building has a white brick chimney, with 23 feet base, towering to a height of 125 feet. The boiler room, 50 x 47 feet, is situated directly to the south of the engine room, from which it is separated by a brick partition wall. The engine room is 74 x 90 feet, and affords an abundance of room. It is unusually well lighted, having 15,000 feet of window surface.

The boiler room contains a battery of four steel return tubular boilers, 73 inches in diameter and 16 feet in length, with ninety $3\frac{1}{2}$-inch tubes. The boilers, which are of the Goldie & McCulloch Company's well-known make, are fitted with Jubilee shaking bars, manufactured by the Jubilee Grate Bar Company, of Toronto, and are connected to a steam main, from which there is a branch to each engine. The total boiler capacity of 700 h.p. will, it is expected, be sufficient to meet the demands for some time to come. Water is fed to the boilers by two duplex boiler feed pumps, 6 x 4 x 7, manufactured by the Northey Manufacturing Company, of Toronto, and there are two Northey jet condensers, 10 x 15 x 15. When connection is made with the C.P.R., as intended, railway freight cars will run close to the power house, from whence the coal will pass by means of a chute direct into the boiler room.

The engine equipment consists of two cross compound Wheelock condensing engines, furnished by the Goldie & McCulloch Company. They have a capacity of 350 h.p. each, running at 86 revolutions per minute. The high pressure cylinders are $17\frac{1}{2}$ inches in diameter, the low pressure cylinders 32 inches in diameter, with a stroke of 42 inches. The massive pulley fly-wheels are 18 feet in diameter and 42 inches in face. A view of the engines is shown in Fig. 2, the second engine appearing in the background. These engines, with their accompanying generators, take up little more than half the space in the engine room, the balance being reserved for additional equipment whenever the traffic of the road shall demand it. The floor is not yet completed, as will be seen by the illustration.

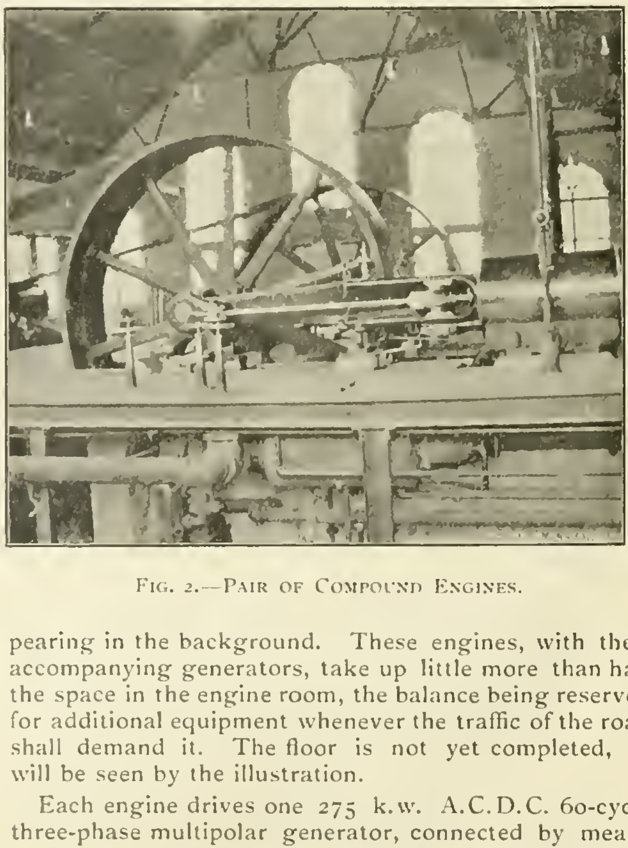


Fig. 2.—Pair of Compound Engines.

Each engine drives one 275 k.w. A.C.D.C. 60-cycle three-phase multipolar generator, connected by means of a 40-inch belt supplied by the Beardmore Belting

Company, of Toronto. These generators, operating at 600 r.p.m., give 550 volts direct current on one side and 350 volts alternating current on the other. The direct current is fed direct to the line and used to operate the section of the road from the power house north to Newmarket, a distance of about 10 miles. The alternating current is delivered to 500 k.w. static transformers, of which there are four, wound for 400 volts primary, situated in the power house, where it is stepped up to a pressure of 16,500 volts. It is then conveyed by the three-wire system a distance of 16 miles to the sub-station at York Mills, where it is passed through step-down transformers and rotary converters and reduced to 550 volts direct current, at which it is delivered to the line for operating the southern portion of the road.

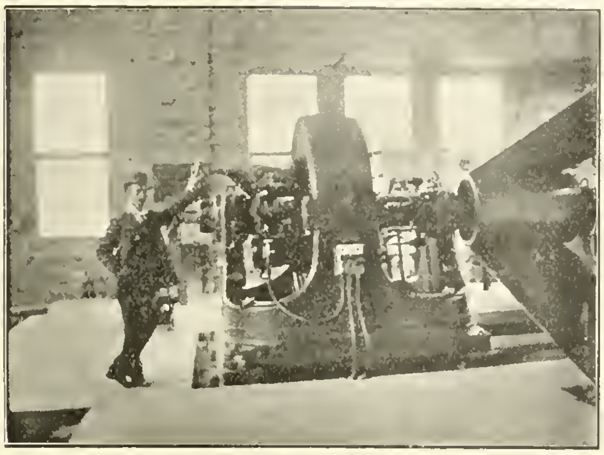


FIG. 3.—ONE OF THE GENERATORS.

The generators above referred to are of the Westinghouse make, and are separately excited by means of exciters belted from the shaft of the generator. The step-up transformers were also manufactured by the Westinghouse Manufacturing Company and are of the self-cooling oil type. Paraffine oil is used, and has been found very satisfactory.

The switch-board in the power house is of marble, mounted on an iron base, and stands six feet from the wall, giving access to all connections back and front. It is 16 feet wide and 8 feet high, and contains eight panels, of which two are alternating current, four direct current, and two double feeder panels. There are in all 13 meters, including 10 ammeters, one direct current volt meter and two alternating current volt meters, the volt meters being hung on swinging brackets so that they can be moved to be visible from all parts of the room. On each panel there are the necessary high tension fuse switches and circuit breakers, and on the back a No. 3 type R 15,000 volt lightning arrestor and one railway tank lightning arrester connecting between the line and the switchboard.

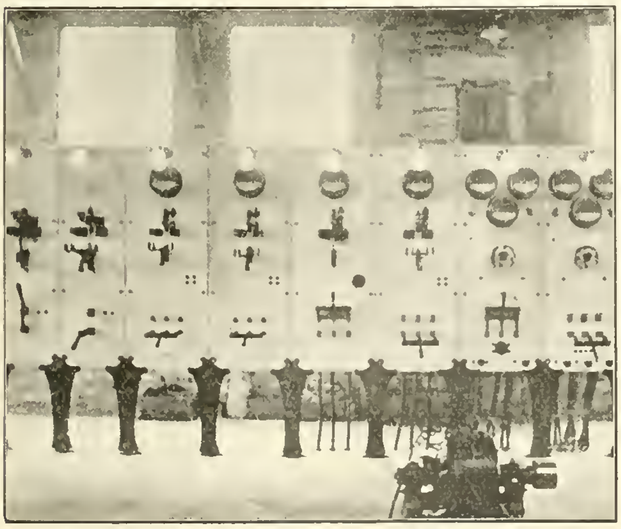


FIG. 4.—GENERATOR SWITCHBOARD.

A general view of the switchboard is show in Fig. 4.

The old power house has been closed, and it is the intention to remove the direct current machine therein to the new station at Bond Lake.

THE SUB-STATION.

The sub-station is located at York Mills, about four and one-half miles from the southern terminus of the road. It is 30 feet wide and 45 feet long, of red brick, but in other respects its construction is very largely a duplicate of the power house.

Its equipment includes four 100 k.w. static transformers wound for 16,500 volts primary and 400 volts secondary. The current is received into these transformers from the power house at 16,500 volts alternating and reduced to 350 volts. At this pressure it is delivered to two 200 k.w. three-phase rotary converters, where it is changed to 550 volts direct current. These converters are operated at 710 r.p.m. and each are excited on one side by an induction motor of 25 h.p., a synchronizing motor for operating the plant being on the other side. The current thus produced is utilized to operate the southern portion of the road, that is, from the C. P. R. tracks to the power house, a distance of about 20 miles.

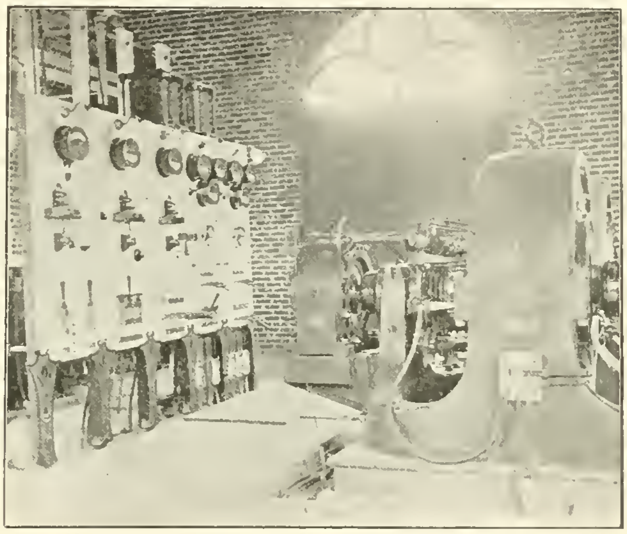


FIG. 5.—INTERIOR OF SUB-STATION.

The switchboard in the sub-station is of marble, containing five panels, two for alternating current for operating the machines, two containing equipment for direct current, and the fifth containing two automatic circuit breakers connected into the line. The first two panels contain three A. C. ammeters, rheostat for controlling the current and switches for controlling the starting motor and the synchronizing motor, all of Westinghouse make. The next two panels contain one D.C. ammeter, one D. C. circuit breaker of latest type, and a three knife switch. The fifth panel contains two circuit breakers, two single knife switches and Weston volt meter. The switches are of the latest type of automatic quick breaking. The equipment of the sub station includes also a 15,000 volt lightning arrester and a Westinghouse tank lightning arrester. The apparatus enumerated occupies but one-half the space in the station, the balance being reserved for additional equipment, if found necessary.

THE POLE LINE.

The poles are of cedar and are set 100 feet apart. They are 38 feet in length, 6 inches at small end, with suspension trolley arms. The insulators are of the ordinary porcelain pattern, and were manufactured by the Imperial Porcelain Works, of Trenton, N.J., and tested to a pressure of 40,000 volts. They are placed 15 inches apart. The high tension line is of No. 4 covered copper wire made by the Montreal Rolling Mills Company. Since the plant was put in operation no trouble has been experienced excepting on one occasion, when, during a heavy east wind, the branches of a poplar tree were blown over the line, causing the two wires to touch and blowing out the circuit breakers in the station. The trolley wire is No. 2 0 and the feed wire No. 4 0 bare copper, with a feeder into the trolley wire every tenth pole. Switches are so arranged that should necessity demand, the road may be entirely operated from either the power house or sub-station.

THE ROAD BED.

As previously stated, the line follows the Yonge street thoroughfare. The construction of the road represents the best engineering practice. There is a ballast of about six inches under the ties, which are of cedar and tamarac and placed about two feet apart. The track is covered in with gravel and ordinary earth. The rails are of the ordinary T pattern, 56 pounds to the yard, bonded to each other with No. 4 0 copper bond and cross-bonded every one thousand feet. It is a single track, with 13 spring switches, which are always open to a car running towards them. The track is placed on the side of the road, so that the ties will just clear the ditch. From the city limits to York Mills it is on the west side, and for the balance of the distance on the east side, it being found that this plan would give the least interference by snow. The track practically follows the grade of the road, the southern portion near the city being fully three inches below the level of the crown of the road, and further north on the level with the crown. Box drains are provided for carrying away the water.

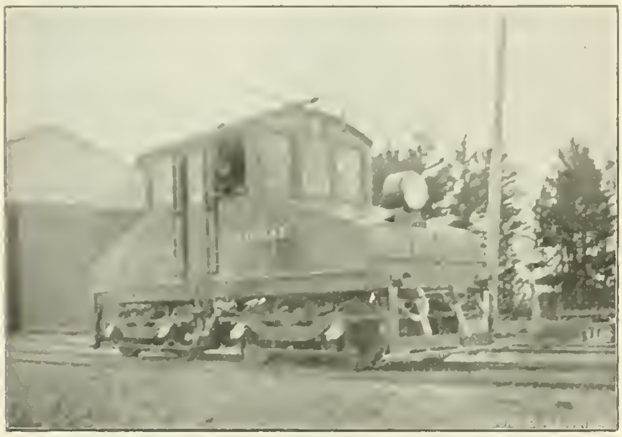


FIG. 6. —BALDWIN-WESTINGHOUSE ELECTRIC LOCOMOTIVE.

The road leaves Yonge street at two points. At Aurora it makes a detour to the west in order to cross the G.T.R. by an overhead steel trestle bridge 125 feet in length, built by the company. The second time is at the side-road at Hon. Wm. Mulock's residence beyond Aurora, where it cuts diagonally across private property for one and one-half miles, and thus reaches the town of Newmarket, where it passes up the centre of the main street. Besides the bridge mentioned, there are two steel girder bridges over the Holland river north of Aurora and a steel bridge 100 feet in length over the Don river at York Mills, all calculated to carry a load of the heaviest steam railway coal cars covering the entire bridge. These bridges were also built by the company.

During the summer the gauge of the road-bed was changed from 4 feet 10¾ inches to the standard gauge of 4 ft. feet 8½ inches. This was done done to permit connection with the C.P.R., it being the intention to connect with that road at North Toronto.

THE GRADES.

The grades on this road are, it is believed, more severe than on any other suburban electric railway in Canada. Starting at the southern terminus the first grade is encountered at Gallow's Hill, it being a north-bound grade of seven per cent. for a distance of 260 feet. At the old power house, about one mile further, there is a south-bound grade of five per cent. for a distance of 132 feet and a north-bound grade of 6.2 per cent. At York Mills, four miles from the southern terminus of the road, there are south-bound grades of 6.4 per cent. for 400 feet and 6.8 per cent. for 700 feet, and one-half mile further on, at the North York Mills hill, 200 feet of 6.2 per cent., 200 feet of 6.4 per cent., 300 feet of 5.8 per cent. and 400 feet of 6.35 per cent., all north-bound grades. At Willowdale there are 1,300 feet of 2.6 per cent. north-bound grade, and at Morgan's Hill, three miles further on, 400 feet of 5.7 and 400 feet of 6.1 per cent. south-bound grades. The steepest grades are found at Thornhill, where there are 100 feet of 5, 100 feet of 6.3, 100 feet of 8, 100 feet of 7.3, and 100 feet of 4.7 per cent. south-bound, and 100 feet of 4.8, 100 feet of 7.8, 200 feet of 8, 300 feet of 7.35, and 100 feet of 5.1 per cent. north-bound grades. At Richmond Hill there is a north-bound grade of 4.25 for a distance of 1,800 feet. Although the main ridges are crossed above Richmond Hill, none of the grades exceed those above given. There are six north-bound grades, varying from 4½ to 5½ per cent. and from 400 to 1,000 feet in length.

ROLLING STOCK.

The company is well provided with rolling stock, having 19 passenger cars built by the Pullman Company and recently overhauled by the company's own mechanics. These cars are double vestibule, heated by coal stoves, and with one exception are mounted on single trucks. Each single truck car has two 30 h.p. motor equipment, the double truck car having four 30 h.p. motors. Five of these equipments are Canadian General and the remainder Westinghouse. They have also four flat cars for hauling local freight. These will be drawn by a Baldwin-Westinghouse electric locomotive of 200 h.p., of which an illustration appears herewith. This locomotive has 33 inch driving wheels, wheel base 16 feet, length over platform 22 feet, and its total weight is 54,700 pounds. It is fitted with four standard 38 B 50 h.p. motors, together with special controllers.

NOTES.

The entire electrical equipment of the system, including the electric locomotive, was furnished by the Westinghouse Manufacturing Company, of Pittsburg, Pa., and installed by the United Electric Company, Limited, of Toronto. The plant is modern in every respect, and notwithstanding the great fluctuations of load caused by steep grades, its operation has been found satisfactory.

Mr. James McDougall, C.E., was engineer in the interest of the county of York and prescribed grades and alignment and looked after the details of construction in that behalf. Mr. W. T. Jennings, C.E., also acted as consulting engineer in a semi-private capacity.

The president of the road is Mr. C. D. Warren, and the superintendent and manager Mr. J. W. Moyes. Mr. Moyes has held this position for about eight years, he having had charge of the road when it was a horse car line. The chief engineer is Mr. John W. Marr, who has been with the company for two years. Previous to accepting this position he was employed by the T. Eaton Company and the Toronto Incandescent Light Company. Messrs. Joseph Lappin and John Mitchell are electricians at the sub-station.

At Bond Lake the company have built a stone, brick and iron car barn, 90 x 36 feet, capable of housing nine cars. The balance will be stored in the old car barn at Deer Park.

The company have purchased 400 acres of land and an hotel at Bond Lake, and it is the intention to establish picnic and camp grounds.

The company have been given the contract for carrying two mails per day each way between Toronto and Newmarket.

Notwithstanding the heavy grades the cars average a speed of about 20 miles per hour without difficulty. A 15 minute service is provided between Toronto and Glen Grove, and between Toronto and Newmarket there are on an average eight cars daily each way.

ENGINEERING and MECHANICS

POWERS, ROOTS, AREAS AND SURFACES.*

By C. R. T. Fessenden.

As engineers have much to do with measuring areas, surfaces, and volumes, a knowledge of powers and roots is necessary.

Powers.—When a given number is multiplied by itself, and the product multiplied again by the number, and so on, these products are called powers of the given number, and what power, or the number of times the given number is used as a factor, is shown by a smaller number written above and to the right; thus 5^2, read five squared, means 5×5, or 25; 5^3, or five cubed, means $5 \times 5 \times 5$, or 125; 5^4, five to the 4th. The 2nd power is called square, and the 3rd the cube.

Roots.—A square root of a given number is that number which, multiplied by itself, will yield the given number. Cube root is that number which, used as a factor three times, yields the given number; and if two numbers are given, the first being a power of the 2nd, then the 2nd is that root of the first, viz., 5 and 25; 25 is the 2nd power or square of 5, and 5 is the 2nd root or square root of 25. When the root of a number is indicated the sign $\sqrt{\ }$ is used. As used alone $\sqrt{25}$ means square root, any other root being shown by a number placed thus, $\sqrt[4]{625}$, reads 4th root of 625. To extract or find the square root of a number, divide it into groups of two, counting from the decimal point. If the last group to the right of the decimal is incomplete, a cipher must be affixed to make it complete. Thus the number 9158.49 is divided into groups of 58, 91 and 49.

```
           9158.49 | 95.7
           81
  180    | 1058
    5    |
  ---    |
  185    |  925
     1900 | 133.49
        7 | 133.49
     ----
     1907
```

Then set down as first figure of root the largest number whose square is not greater than the left hand or first group (1st group 91, largest number 9); place its square (81) under first group and subtract ($91 - 81 = 10$). Bring down next group (58), making a dividend (1058). Multiply the root so far obtained by 20 for a trial divisor ($9 \times 20 = 180$), divide dividend by trial divisor and place quotient (5) as next figure of root, also add it to the trial divisor ($180 + 5 = 185$); multiply sum of trial divisor and last root figure by last root figure ($185 \times 5 = 925$), and subtract from trial dividend; to the remainder (133) annex next group, which is a decimal, ∴ place decimal (.) in root, multiply root (95) by 20, and proceed as before. If there is a remainder, bring down groups of ciphers, always remembering when you come to decimal point to place it in the root.

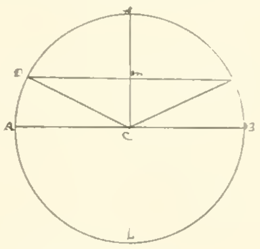
To extract $\sqrt{\ }$ of vulgar fraction reduce to a decimal, unless both numerator and denominator are perfect squares, when their $\sqrt{\ }$ may be written down as $\sqrt{\frac{9}{16}} = \frac{3}{4}$, $\sqrt{\frac{1}{2}} = \sqrt{.5} = \sqrt{.50}$.

```
          480048.687 | 78.3
          343
  14700 | 137048
   1680 |
     64 |
  ----- |
  16444 | 131552
  1825200 | 5496687
     7020 |
        9 |
  ------- |
  1832229 | 5496687
```

To extract cube root point into groups of three figures, beginning at decimal point; place in root the largest number (7) whose cube is not greater than first group (480), placing its cube (343) under first group. Subtract, and to the remainder (137) bring down next group (048.), making a dividend of 137048. Next, for a trial divisor take 300 times the root squared ($7^2 \times 300 = 14700$), divide, and place quotient (8) as next figure of root; multiply root by last figure added and multiply product by 30 ($7 \times 8 \times 30 = 1680$), which add to trial divisor, also add square of last figure ($8^2 = 64$). Multiply this sum (16444) by the last figure of root (8); subtract from dividend 137048, and to the remainder bring down next group (.687), placing decimal in root; square 78 and multiply by 300 for trial divisor (1825200); quotient is 3; place in root and multiply root 78 by 3 and product by 30 ($78 \times 3 \times 30 = 7020$). Add last root figure squared (3^2 or 9), making 1832229; multiply by last root figure, and proceed as before. If remainder of the last group is brought down, bring down groups of ciphers.

In case other roots are wanted than square and cube, it is necessary to use a table of logarithms, except $4\sqrt{\ }$, which is the square $\sqrt{\ }$ of the square $\sqrt{\ }$.

Areas and volumes.—The principal figures the engineer uses are circles and cylinders and their parts, and for the volume of cylinders: In the circle A H B the line A B is a diameter, the lines D C, H C and F C are radii; the space inside the line A D H F B L is the area of the circle; the space inside A D H F B is a semi-circle; the space C D H F C is a sector of the circle; the space D F H is a segment; the line D F is a chord; the line D F H is an arc of sector C D H F.



Diameter × 3·1416 = circumference.
40 × 3·1416 = 125·664″.
Diameter² × ·7854 = area. Suppose circle is 40″ in diameter.
Thus area = 40 × 40 × ·7854 = 1256·64 sq. in.
Radius² × 3·1416 = area. Radius = ½ diameter.
20² × 3·1416 = area = 1256·64 sq. in.
$\frac{\text{Diameter}^2 \times {\cdot}7854}{2}$ = area of semi-circle.

Area of sector is radius × arc and product divided by 2, thus radius = 20, arc = 45, area = $\frac{20 \times 45}{2}$ = 450 sq. in. Area of segment D F H = area of sector C D H F C minus area of triangle C D F; area of triangle C D F = chord D F × ½ height of triangle M C (12″). Chord D F = 35 = $\frac{12 \times 35}{2}$ = 210 sq. in. Surface of tube = circumference in inches × length in inches. Thus a 3″ tube 12 ft. long is 3 × 3·1416 × 12 × 12 = 1671·3312 sq. in.

Volumes of cylinders are found by multiplying area of end by length, both in inches or feet; thus a boiler 60″ in diameter by 14′ long, area of end = 60² × ·7854 = 2827·4 sq. in.; volume = 2827·4 sq. in. × 14 × 12 = 374763·2 cu. in. Volume of segment of cylinder = area of segment of end × length; thus steam space in 60″ boiler, water 45″ deep; by rule area of segment of end 15″ deep = 120 sq. in.; length = 14 × 12″; steam space = 120 sq. in. × 14 × 12 cu. in. = 19160 cu. in.

Volume of box = area of end × by length; thus box 8 ft. deep by 4 ft. long by 5 ft. wide = 8 × 4 × 5 = 160 cu. ft.

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* Paper read before Hamilton No. 2, C.A.S.E.

AMONG THE ENGINEERS.

Mr. James Newton has been appointed engineer at the waterworks at Hintonburg, Ont., which were recently completed.

Mr. James May, of Essex, has accepted the position of engineer in the wood-working factory of Gardner Bros., Leamington, Ont.

Mr. Thos. Eversfield, who for upwards of twenty years was engineer at Toronto University, is now representing the James Morrison Manufacturing Co., of Toronto, on the road.

Mr. D. C. McLean, who for many years has been chief engineer at the power house of the Toronto Railway Company, recently resigned to accept a position in Glasgow, Scotland. He has been succeeded by Mr. Thomas Merry.

Mr. Peter Peterson, first engineer in the Canadian Packing Co.'s factory at London, Ont., was caught in the belting while oiling some shafting and instantly killed. Deceased had but recently qualified for the position of engineer.

The employees in and around the power house of the Toronto Railway Company have organized the Toronto Street Railway Company Electrical and Mechanical Association. The main object of the association is to provide sick benefits. The president is Mr. G. J. McCullough, chief electrician, and the secretary Mr. William Cox.

Mr. John Tucker, of Hintonburg, Ont., was almost instantly killed by the explosion of a 15-horse power boiler at the Chaudiere in Ottawa. The boiler was being used to provide power for running a stone crusher, and it is said that there was 60 pounds of steam on and plenty of water in the boiler. Deceased was 90 feet away at the time of the explosion, driving a cart, and was struck by the driving wheel. The jury empanelled to inquire into the circumstances brought in a verdict that the explosion was caused by a deposit of dirt in the bottom of the boiler, which resulted in overheating and consequent sudden expansion. They also found that the by-laws relating to steam boilers had not been enforced, and recommended that the government, in the interest of the general public, appoint a provincial boiler inspector.

The Consumers Cordage Company, of Montreal, have lately improved their engineering department, having put in a Wheelock engine of 250 h.p., low pressure, a Brown low pressure engine of 400 h.p., condensing engine and six steel tubular boilers built by White & Company, of Montreal. The Brown engine was built by the Polson Company, of Toronto, and the Wheelock engine by the Goldie & McCulloch Company, of Galt. When these engines are in operation there will be 700 h.p. installed. The boilers are 75 h.p. The plant is under the supervision of Mr. John Killfeather and Mr. M. Rochford.

SPARKS.

Messrs. Young Bros., of Almonte, Ont., have installed a dynamo for lighting their works.

In Athens, Ont., there is an agitation on foot to install an electric plant for street lighting.

The citizens of Oakland, Man., are endeavoring to secure telephone connection with Portage la Prairie.

The Schofield Woollen Company, Paris, Ont., are installing a 12 k.w. Edison dynamo for lighting their works.

The Maritime Electric Company, dealers in electrical supplies, Halifax, N.S., are reported to have assigned.

A by-law will shortly be submitted to the ratepayers of Nelson, B.C., to raise $7,000 for electric light purposes.

A by-law to raise $7,000 for electric light purposes was carried by the ratepayers of Campbellford, Ont., a fortnight ago.

J. G. Field, of Tavistock, Ont., is installing a 30 k.w. standard alternator of the Canadian General Electric Company's make.

The city council of St. Thomas, Ont., have awarded to the Bell Telephone Co. the contract for supplying a fire alarm system.

The Poorman Mine, Nelson, B.C., is installing a 50 h.p. induction motor of the Canadian General Electric Company's make.

The Toronto Railway Company are adopting electric welding of rail joints, the intention being to apply this method to the entire system.

The Linde British Refrigeration Company have bought from the Canadian General Electric Company one 30 h.p. and one 10 h.p. induction motor.

At the next meeting of the city council of Brockville, Ont., an estimate of the cost of installing an electric plant for street lighting will be submitted.

Mr. A. B. Rice has made application to the town council of Toronto Junction, Ont., for permission to supply electricity for light and power purposes.

The Montague Electric Company, Prince Edward Island, have purchased a 500-light standard alternator from the Canadian General Electric Company.

A committee of the town council of Milton, Ont., have asked the Milton Electric Light Company to state upon what terms they will sell the plant to the town.

The Canadian Colored Cotton Company, of Milltown, N.B., have bought two 55 k.w. multipolar 125-volt generators from the Canadian General Electric Company.

The town of Levis, Que., is about to install an electric light system, for which plans are invited by F. Roy, secretary-treasurer of the municipality, up to January 1st.

The Canadian Pacific Railway has given a contract for one 200 h.p. 550-volt induction motor for the Trail Smelter at Nelson, B. C., to the Canadian General Electric Company.

The Sarnia Street Railway Co., at a recent meeting, decided to take steps at once to convert the road into an electric system. Mr. J. S. Symington is president of the company.

The Callfornia Mine of British Columbia have ordered from the Canadian General Electric Company one 150 h.p. 2,080-volt induction motor for operating their compressor plant.

The Montreal Cotton Company, of Valleyfield, Que., have ordered one more 100 h.p. and six more 50 h.p. induction motors from the Canadian General Electric Company.

Before the Canadian Institute in Toronto Prof. C. A. Chant, of Toronto University, delivered a lecture on wireless telegraphy, with lantern illustrations and instrumental demonstrations.

Tenders have been taken for building a power house for a municipal electric light plant at Halifax, N.S. The city engineer is to furnish an estimate of the cost of electrical equipment.

The Montmorency Cotton Mills Company, Montmorency, Que., have purchased a 60 k.w. direct-connected unit, with Robb-Armstrong engine, from the Canadian General Electric Company.

The St. Croix Gas Light Company, St. Stephens, N.B., have purchased from the Canadian General Electric Company an A.S. 8-120-900-2,080-volt alternator, with exciter and switchboard.

The Arnprior Electric Light and Power Company have been given a contract to light the streets of the town by arc lights. It is understood to be the intention of the company to remodel their plant.

The Penman Manufacturing Company, of Coaticoke, Que., have bought an M.P. 4-30 1050-125 volt generator for lighting purposes in their factory. The contract also includes the wiring of 350 16-c.p. lamps.

The Metropolitan Railway Co., of Toronto, which have now built their line to Newmarket, are said to have decided upon further extensions northward, for which the contracts will likely be let an early date.

Chief Buchanan, of the Winnipeg Fire Brigade, has submitted to the city council an estimate of the cost of a repairing plant. Using gasoline engines the cost is placed at $5,840, and using electric power, $5.340.

The council of Toronto Junction, Ont., are considering the question of increasing the municipal plant to such an extent as to furnish commercial lighting. It is estimated that this would entail an expenditure of $3,000.

Mr. Wm. Shaw, while showing a friend through the electric light works at Brandon, Man., accidentally walked into a large fly wheel revolving at a rapid speed. He was seriously injured and died a few days afterwards.

The Lachine Rapids Hydraulic & Land Company, of Montreal, are supplying to the Colonial Bleaching Company, of that city, induction motors aggregating 175 h.p., all of which are to be made by the Canadian General Electric Company.

The corporation of Prescott, acting under advice of their consulting engineer, have purchased their electric plant from the Canadian General Electric Company. This will consist of a 2,000-light 2,080-volt alternator with switchboard complete.

Plans have been prepared for the electric power transmission plant of the Kalamazoo Valley Electric Co., of Allegan, Mich. It is proposed to transmit the current, at a pressure of 40,000 volts, from Allegan to Jackson, a distance of 90 miles.

The Sutherland Improvement and Development Co., of New York, have deposited with the town council of Niagara Falls, Ont., a cheque for $1,000 in connection with the proposed conversion of the local street railway line to an electric system.

The Niagara Falls Park Commissioners have reached an agreement with the Fort Erie Electric Railway Company under which the latter agrees to extend its line for a distance of 13 miles along the bank of the Niagara river to Slater's Point.

The Dominion Steel & Iron Company, of Sydney, have placed their order with the Canadian General Electric Company for their electrical requirements. The initial plant will consist of two 125-k.w. 250-volt generators, with generator and feeder panels, and one 100 h.p. 250-volt motor.

The St. Thomas Gas Company, St. Thomas, Ont., have just finished the installation of a Brush arc dynamo having a capacity of 125 lamps. This machine embodies all the latest improvements in arc dynamo construction, and was purchased from the Canadian General Electric Company.

The council of Shelburne, Ont., recently submitted an offer to the Shelburne Electric Light Company to purchase their plant. This offer was refused, and as an arbitrator was not appointed by the company within thirty days thereafter, the council submitted a by-law to the ratepayers to authorize the purchase of a municipal lighting plant. The vote was taken on November 24th, and resulted in the defeat of the by-law by 32 votes.

The Niagara, St. Catharines and Toronto Railway Company have placed their order with the Canadian General Electric Co. for their entire motor equipment, consisting of six 4 motor and four 2 motor equipment. It will be remembered that this company has taken over the Niagara Central railway, with the intention of extending it ultimately to Toronto, and the Canadian General Electric Company is to be congratulated upon securing such an important order.

Mr. W. A. Turbayne, E.E., of Hamilton, has reported to the council of Woodstock, Ont., on the value of the plant of the Woodstock Electric Light Company, the taking over of which is under consideration by the council. He reports that $1,650 would be required for improvements, including $800 for reserve arc dynamo, $550 for lamps and weatherhoods, and $300 for alterations on line. To provide for an all night service a reserve engine and boiler would be required, at a cost of $3,200.

THE AUTOMOBILE.

It doesn't shy at papers
  As they blow along the street ;
It cuts no silly capers
  On the dashboard with its feet ;
It doesn't paw the sod up all around the hitching post,
  It doesn't scare at shadows as a man would at a ghost ;
It doesn't gnaw the manger,
  It doesn't waste the hay,
Nor put you into danger
  When the brass bands play.

It makes no wild endeavor
  To switch away the flies ;
It sheds no hair that ever
  Gets in your mouth and eyes :
It speeds along the highways and never looks around
  For things that it may scare at and spill you on the ground !
It doesn't mind the circus,
  It's not at all afraid ;
And it doesn't overwork us
  When the elephants parade.

It doesn't rear and quiver
  When the train goes rushing by ;
It doesn't stand and shiver
  When the little snowflakes fly ;
It doesn't mind the thunder nor the lightning's blinding flash ;
  It doesn't keep you chirping and connecting with the lash ;
It never minds the banners
  They display on holidays,
It's a thing of proper manners,
  Which it shows in many ways.

When you chance to pass its stable
  You do not have to care
Or cluck for all your able
  To keep from stopping there !
It will work all through the daytime and still be fresh at night ;
  There is no one to arrest you, if you do not treat it right !
Its wheezings ne'er distress you
  As it moves along the way—
Farewell old Dobbins ; bless you !
  You were all right in your day.

—Chicago Times Herald.

TRADE NOTES.

The corporation of Goderich, Ont., have accepted the tender of Sadler & Haworth, of Toronto, for supply of leather belting, at the price of $1.10 per foot for 13 inch and $2.95 per foot for 28 inch.

The Dominion Iron & Steel Co. has placed an order with the Robb Engineering Co. for two 150 horse power engines for electric lighting purposes. They have also recently bought from the Robb Co. a number of smaller engines and boilers for temporary use during the erection of their extensive plant.

The Goldie & McCulloch Co., Limited, Galt, Ont., continue to be busy in all their departments. As an indication of this we give a partial list of their shipments for the week ending November 25th.: Several large safes and vault doors, gas engines, 3 cars of flour mill machinery to different parts of the North-West, one car of same to Lucan, one carload of machinery, including boiler, etc., to Hamilton. There was also the usual amount of minor shipping.

The Macdonald Mfg. Co , of this city, will use in their new factory on Catharine street all the latest devices for the successful production of tinware, and among the rest they have decided to use electricity as a distributing medium in their power plant. They will use the Canadian General Electric Co.'s well known apparatus, consisting of a 60 k.w. direct connected generator and several motors of various sizes which will be either direct connected to the individual machines or to lines of shafting. The building will also be lighted throughout with incandescent lamps.

We were pleased to notice above the entrance to No. 30 Wellington street east, Toronto, a sign bearing the familiar name of "F. E. Dixon & Co". Enquiry elicited the fact that Mr. F. E. Dixon, who was for many years engaged in the manufacture of leather belting in Toronto, has resumed business in the same line. The firm have been appointed agents for Messrs. Morris & Co., manufacturers of leather and leather belting, London, Eng. (established 1775). Mr. Dixon reports that some of his old customers have already found their way back to him, and he hopes to see others in addition to many near ones.

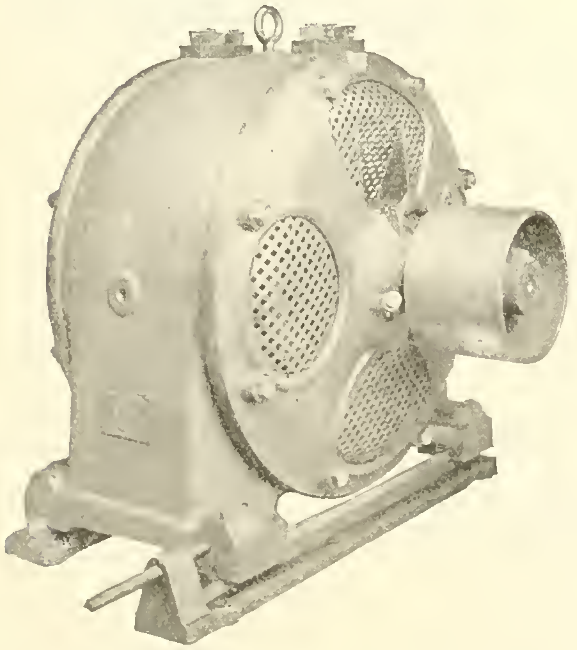
The United Electric Co., Limited, of Toronto, report the following recent sales of motors : E. S. Stephenson & Co., St. John, N. B., four standard type motors ; Shaw, Cassels & Co., Bracebridge, Ont., one 40 h.p. multipolar motor ; Bertram & Sons, Dundas, Ont., two slow speed multipolar motors for direct gearing to large iron-working tools ; McLaren Manufacturing Co., Montreal, Que., one motor ; Oelschlager Bros., Berlin, Ont., one elevator motor ; Northey Manufacturing Co., Toronto, one standard motor ; Ryrie Bros., jewelers, Toronto, motors for operating their cash system ; Montmorency Cotton Mills Co., three standard motors for service in their mills at Montmorency Falls, Que.

MOONLIGHT SCHEDULE FOR DECEMBER.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1....	P.M. 5.00	A.M. 6.00	13.00
2....	" 5.00	" 6.00	13.00
3....	" 5.00	" 6.00	13.00
4....	" 5.00	" 6.00	13.00
5....	" 5.00	" 6.00	13.00
6....	" 6.00	" 6.00	12.00
7....	" 7.50	" 6.00	10.10
8....	" 10.00	" 6.00	8.00
9....	" 11.00	" 6.10	7.10
10....	" 11.10	" 6.10	7.00
11....	....	" 6.10	5.50
12....	A.M. 12.20	....	
13....	" 1.30	" 6.10	4.40
14....	" 2.40	" 6.10	3.30
15....	No Light.	No Light.	.....
16....	No Light.	No Light.	.....
17 ...	No Light.	No Light.	.....
18....	P.M. 5.00	P.M. 9.20	4.20
19....	" 5.00	" 9.20	4.20
20....	" 5.00	" 9.20	4.20
21....	" 5.00	A.M. 2.30	9.30
22....	" 5.00	" 2.30	9.30
23....	" 5.00	" 2.30	9.30
24....	" 5.00	" 2.30	9.30
25....	" 5.00	" 2.30	9.30
26....	" 5.10	" 2.10	9.00
27....	" 5.10	" 3.10	10.00
28....	" 5.10	" 4.20	11.10
29....	" 5.10	" 5.20	12.10
30....	" 5.10	" 6.20	13.10
31....	" 5.10	" 6.20	13.10
		Total.........	252.30
		Grand Total...	2,196.40

The Hamilton Steel & Iron Company have placed a contract with the Canadian General Electric Company for a direct-connected 75-k.w. 250-volt generator for operating their electric cranes.

A company of Canadian capitalists has been formed to construct and operate an electric railway system at Georgetown, Demarara, West Indies. Sir Wm. Van Horne is president of the company, and Mr. W. B. Chapman, of Montreal, an active director.



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Induction

Motors

The orders received by us in Montreal alone for this class of motor during the last four months aggregate over

4,000 H. P.

In Service in All Trades.

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AGENTS FOR CANADA

SPARKS.

The Ottawa Electric Co. are installing a storage battery equipment to regulate the current on power circuits.

The Lake Megantic Electric Company are replacing their 30 k.w. alternator with one of 60 k.w. output. The Canadian Electric Company have the contract.

The Chambers Electric Co., of Truro, N.S., are installing another 55 k.w. multipolar generator of the Canadian General Electric Company's make.

The Palmerston Carriage Co., of Palmerston, Ont., are installing in their factory an electric light plant, furnished by the Royal Electric Company.

The town council of Prescott, Ont., has decided to raise $15,000 by debentures for the purpose of installing an electric plant for street and commercial lighting.

Mr. T. R. Deacon, of Rat Portage, Ont., has made a survey of the Whitefish rapids, with a view of determining the cost and feasibility of developing the water power for mining purposes.

The Stanstead Electric Light Company, of Stanstead, Que., have lately made improvements to their plant, putting in new armatures and changing the voltage from 1,000 to 2,000 volts.

The Berlin Rubber Co., of Berlin, Ont., are installing a 17 k.w. direct current 125 volt generator in their factory for lighting purposes. The order has been given to the Canadian General Electric Co.

The Winnipeg Street Railway Company are installing another 150 k.w. monocyclic generator with panel, to supplement those already in use. The order was placed with the Canadian General Electric Company.

The Consnmers Cordage Company, of Dartmouth, N. S., are installing a multipolar 6-30-125 volt generator of the Canadian General Electric Co.'s make, which will be driven by a Robb-Armstrong engine.

The Canada Electric Co., of Amherst, N.S , whose generating plant was recently destroyed by fire, has purchased two direct current 55 k.w. multipolar generators and switchboard from the Canadian General Electric Co.

It is pleasing to note the increase of power business in connection with alternating lighting plants, especially when monocyclic machines of the Canadian General Electric Company are in use. The Hanover Electric Light Company are just putting on another 20 h.p. induction motor.

A serious but peculiar accident occurred at Point St. Charles, Que., by which Geo. Pierce was instantly killed. Deceased was pressing ashes into a cylinder, holding in his hand a long iron pole which he was using. The pole met an obstruction, causing him to raise it up quickly, thus breaking the globe on an arc light above his head and forming a circuit, by means of which the current passed into his body, death resulting immediately.

The corporation of Weston, Ont., have placed a contract with the Canadian General Electric Company for a complete lighting plant for the town. They will use alternating arc lamps for street lighting, and the generating plant will consist of a standard 30 k.w. alternator and switchboard operated by an Ideal engine.

The premises of the Toronto Carpet Mfg. Co., of Toronto, are now lighted by electricity. The Canadian General Electric Company have just completed the work of installation, which included the supplying of a steel frame 55 k.w. generator with switchboard, and the wiring up of about 300 16 c.p. lamps.

The Helois Company of Colonge, Germany, will begin early next year to erect a large plant in the province of Posen, for the distribution of electricity for lighting and power purposes over an extensive agricultural district. The distributing mains will extend for a distance of 15 miles around the station. Not only is it intended to supply current for lighting purposes and operating dairy machinery, but also for driving agricultural implements, such as threshing machines, plows and chaff cutters. It is estimated that the undertaking will cost about $1,300,000. The Helois Company have already made arrangements with land owners in the district in which the plant is to be erected for the annual plowing of their land. For this purpose 40 plowing machines will have to be provided, and the work must be done, according to agreement, between July 15 and Dec. 1 every year.

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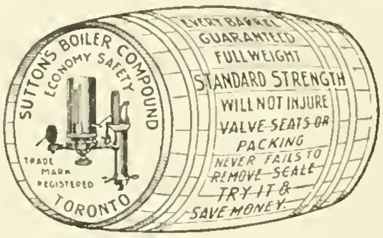

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Victor Turbines
OPERATING DYNAMOS

That there are more Victor Turbines in use supplying power for electric generators than any other, is due to the many points of superiority possessed by this Turbine.

FEATURES WORTH REMEMBERING

High Speed, Close Regulation, Great Capacity
High Efficiency, Perfect Cylinder Gate, Steady Motion

RECENT PLANTS INSTALLED:—Lachine Rapids Hydraulic & Land Co., Montreal, Que., 12,000 h.p.; Chambly Manufacturing Co., Montreal, Que., 20,000 h.p.; West Kootenay Power & Light Co., Rossland, B.C., 3,000 h.p.; Dolgeville Electric Light & Power Co., Dolgeville, N.Y.; Honk Falls Power Co., Ellenville, N.Y.; Hudson River Power Transmission Co., Mechanicsville, N.Y.; Cataract Power Co., Hamilton, Ont.

CORRESPONDENCE SOLICITED.

The Stilwell-Bierce & Smith-Vaile Co. = *DAYTON, OHIO. U. S. A*

Scientific American, Oct. 14, 1899.

THE AUTOMOBILE MAGAZINE has at last come to hand and is the most thoroughly satisfactory periodical which we have seen in any language on the subject. It is of regular magazine size and has 111 pages. The quality of the articles is very high and the illustrations are of the best. Everyone who is at all interested in the automobile will find something in the new magazine which will interest him. Even the social side is far from being neglected, as there is an article on the recent floral parade at Newport and on the Automobile Club of France. The Automobile Index, which occupies some nine pages, is exactly what has been needed. On the whole the magazine is a most satisfactory one.

SUBSCRIBE TO

THE AUTOMOBILE MAGAZINE

31 State Street,
NEW YORK.

$3.00 A YEAR.

N.Y. Evening Post, Oct. 9. 1899.

The new illustrated AUTOMOBILE MAGAZINE (New York: U. S. Industrial Publishing Co.) has a very attractive appearance, and is so varied in contents, without undue padding, that one wonders how the editor can fill his pages hereafter. Still, the list on page 101 shows that there is a considerable "foreign automobile press;" and what foreigners can do in the way of furnishing "copy" to the printer, Americans can. The society feature of the new vehicle is brought to the front with news from the Newport festival—the driver, by the way, not always sitting on the left. There are competent-seeming book reviews, and some concessions are made to the general reader in comicalities of pencil and verse. The magazine seems free from bias.

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